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A SERIES OF EXPERIMENTS ON THE LEARNING OF FRENCH VOCABULARY

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A SERIES OF EXPERIMENTS ON THE LEARNING OF FRENCH VOCABULARY

BY
LOUISE C. SEIBERT

A DISSERTATION

submitted to the Board of University Studies of The Johns Hopkins University in conformity with the requirements for the degree of Doctor of Philosophy.

1929

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L. C. S.

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CHAPTER I

The Growth of the Problem

The writer was prompted to undertake these experiments by the need which was actually felt in the class room for such information.

How do students study normally? What is the best method of studying foreign vocabulary so that it will not only take less time, but will also be remembered better? Assertions are made from time to time in books on the teaching of foreign languages. Are these assertions justified by facts or results of experiments? Learning processes are studied with certain material. Do their results hold for other material? Can we, for instance, apply the results found with non-sense syllables to linguistic material such as foreign vocabularies? Experiments have been made on passive memory. Would the results be the same for active retention or recall?

These questions and many others led to the following investigations. There is nothing in them which is strikingly new; they are really old inquiries done over with the more modern tools for group experimentation, with the material carefully limited to French vocabulary, and the exclusive study of a part of memory very little tested for linguistic material: i. e., active memory or recall.

In the teaching of foreign languages, we strive to teach the writing and speaking of the language as well as its reading and understanding. It was not so long ago that a reading knowledge of the language was considered sufficient. Consequently, practically all the experiments which have been done in the field of foreign language have to do with the recognition of the vocabulary. That recognition and recall are too entirely different processes is generally recognized by psychologists. Recognition is on the threshold of memory; recall is the last and most complex function of the memory process. In his "Comparative Study of Recognition and Recall,"

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G. C. Myers finds that there is a surprising low correlation between recall and recognition and that the recognition efficiency is about two and one-half times that of recall.[1] A. L. Lee in his "Experimental Study of Retention and Its Relation to Intelligence," found also that there was a small correlation between recognition and recall, and concluded that "recognition and recall can scarcely be treated as identical processes of different levels with reference to a threshold of retention."[2]

In the recall of foreign words another factor enters, that of memory for orthography. F. Kuhlman in his experiment on the memory consciousness in orthography says: . . . . "Learning the spelling of a word is quite a different process from memorizing a group of words, and the fact that under certain conditions auditory presentation for the latter is better than the visual, does not permit any conclusion to be drawn with reference to the relative value of these methods of presentation in learning the spelling of a word."[3]

These conclusions if accepted would show that we cannot accept the findings of experiments dealing with recognition as being transferable to the recall of linguistic material. Since only a few of the experiments made in this field are on recall, there was an open field for this research study.

A great many experiments on linguistic material were made at a time when the technique of group experimentation was not yet developed. Numerous experiments were made upon very few subjects (generally from one to five). Several other studies of groups are of very little value because of the lack of proper precautions, control, or statistical treatment. Indeed, in reading some of these experiments carefully, one is amazed at the far reaching conclusions that some writers, especially those on methods of teaching, have been willing to

[1] Myers, G. C.: Comparative Study of Recognition and Recall. Psychological Review, Vol. 21, pp. 442. 1914.

[2] Lee, A. L.: An Experimental Study of Retention and Its Relation to Intelligence. Psychological Monographs, Vol. 34, No. 4, p. 154. 1925.

[3] Kuhlman, F.: On the Analysis of the Memory Consciousness. A study in mental imagery and memory of meaningless visual forms. Psychological Review, Vol. 13, pp. 316-348. 1906.

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derive from them. It is quite fitting and proper that the teaching methods should take into account the findings of experimentation. But there is such a thing as the weighing of evidence, and the discriminating between those findings which are significant and scientific and those which are not. Furthermore, one or two experiments are very rarely conclusive enough to justify a change of method. The really scientific experiment has to be so minute, that a great number of them must be made before a really worth-while body of knowledge can be obtained.

In this body of linguistic experiments, the material used has been chiefly non-sense syllables. This material was, we believe, first used by Ebbinghaus[4] in his famous work on memory, and has been used since by a number of experimenters. We are now beginning to think that the results found in experimenting with non-sense syllables hold true for non-sense syllables only and for nothing else. By what stretch of imagination was it thought that such results would hold for the memory of meaningful material or foreign words? That, we do not know. However, later experiments seem to justify amply the stand first taken by Professor Cattell,[5] that results for meaningful material were quite different from those for non-sense syllables. Likewise, there is a vast difference between the results obtained with foreign vocabulary and non-sense syllables. To begin with, the make-up of the syllables was very much alike: same number of letters, same place for the vowel, etc., and each syllable had very little individuality. This is not true with words. Each one has a certain physiognomy which plays an important part in the memory of the word. When we recall it; we see it, its length, the number of letters above or below the line, and the like. With that physiognomy is associated the meaning proper, the concrete thing that it represents. To say that all these associations which do not come into play in non-sense syllables

[4] Ebbinghaus, H.: Memory—Translation by H. A. Ruger and C. E. Bussenius, Teachers College, Columbia University. Educational Reprints, 76-79.

[5] Cattell, J. W.: Measurements of the Accuracy of Recollection. Science, N. S. II.

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are negligible is to assume much that is not warranted. Consequently, it is with the utmost caution that results of experiments on this material could be transferred to the field of foreign language. Further experimenting on words was needed to corroborate these findings.

There is a great deal to be done in the field of foreign languages. Previously made experiments should be repeated with better control; new ones should be devised to add to the knowledge already obtained; assertions based upon assumptions should be scientifically proved. Psychological processes are complex things, so many elements come into play, and so often unrelated or unforeseen influences upset the expected results of our logical conclusions. The student can find an endless source of problems to work out, simply by questioning assumptions which at first appear to be irrefutable. It is our experience that the working of each problem has been the starting point for a multitude of other problems which need to be solved. For one thing, and one thing only can be found at a time; let one condition be changed and you have a new problem. There has been a great deal done in this field, but it is our impression that it is only a beginning and that a great many problems are still left unsolved for generations of research workers.

The investigation submitted here is only an example of how a problem grows. We started to solve one problem, and dozens followed which are yet unsolved.

The first problem started in the class room. Students who could write their lessons quickly and faultlessly, sometimes had difficulty in reciting them orally. They were not used to speaking the language, and it was not so much a question of not knowing the words or their pronunciation as it was a lack of proper coordination in the movements of their lips and tongues. There was an evident need of practice; therefore the experimenter advised the students to study their lessons aloud so as to get an automatic control of their vocal organs. Some students objected, saying that they could not study aloud, others were afraid it would take more time. It was then proposed to them that they find the truth by experi-

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mentation. They agreed to do so. In this way, not only the interest of the class was secured in the solving of its own problem, but at the same time they, with the author, studied how to devise such an experiment in a scientific manner. This was the first experiment, i. e., the most efficient way to study a vocabulary, either silently or aloud, or with a written recall.

The group was progressing very nicely, when a colleague told the experimenter that she was wasting her time. "You know," she said, "that the old method of studying vocabularies by associated pairs has been discarded in favor of studying the words in context." "Do you know," the experimenter asked, "whether there has been any experiment on the subject?" She did not. After a careful search only two rather inconclusive experiments were found. Hence the author started one of her own, and this was the experiment of vocabulary studied in associated pairs *vs.* vocabulary studied in the context.

While the experiment was in progress, it was found that several students learned the whole list of twelve words at a time. This was surprising to the author, but several students assured her that they found it much quicker to learn the whole list at one time. So this led to the third experiment, i. e., whole *vs.* part method in studying a list of associated pairs.

During this experiment, the studying was done by reading the list a certain number of times. The results compared with the results of other experiments showed that reading may not be as good a means of memorizing as part reading and part recitation. This started the fourth experiment of reading *vs.* recitation.

In devising these experiments, some relearning periods were provided. At first, the amount of relearning was stated not in terms of time, but by a perfect reproduction of the material. Later on, when the element of time had to be uniform, the time for relearning had to be arbitrarily set. Then the question arose: What was the optimum time of relearning? This furnished the material for the last two experiments.

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From these experiments some by-products, naturally, were to be expected, and they have been summarized in the last chapter of this dissertation.

On practically every one of the problems under consideration, there had been some work done. On some of them a considerable bibliography is to be found. It is the purpose of this study to treat each experiment with its historical background separately, as the attempt to treat this work as a whole would be almost impossible. Furthermore, each of these experiments deals with a learning process which has been experimented upon, quarrelled and fought over many times, and it seemed more interesting to relate each experiment to its proper setting than to attempt to find a background common to all.

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CHAPTER II

Method. Procedure. Material.

These various experiments have several things in common which can be treated under the same headings, i. e., the material used, the method, and the procedure adopted.

All the experiments relate to the learning of French vocabulary. The learning of sentences has been left for further experiment. The learning is always active, that is, the reproduction of the foreign word is always required.

The vocabulary used was chosen with great care. The selection of words was based upon the following principles:

(a) The words had to be unknown to the group. It is true that this could not be ascertained absolutely until the time of the experiment, but the groups tested were well known to the investigator, who relied upon her experience of the vocabulary likely to be known by the students and selected words outside it. At the time of the experiment, precautions were taken to eliminate from the group any students who happened to know one of these words.

In this selection, technical, obsolete or rare words in English were avoided, as their possible unfamiliarity to the student may have vitiated the value of the experiment. Also words of Latin origin were omitted as their similarity with the French word throws them out of the class of the usual foreign words. However, a list of about 400 words was temporarily established.

(b) From the list, several series of twelve words each were made, and in such a way, that the series would compare favorably with each other in respect to difficulty. This was not an easy task, for immediately the question arose: What constitutes the difficulty of a foreign vocable? The length of the word? The difficulty of its spelling? The difficulty of its pronunciation? The greater or less familiarity with its meaning? The lack or the presence of complex associations in the mind of the student learning it at the time? The place it

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may happen to occupy in the list? The problem, we think, has not yet been solved. The relative difficulty of a given list may be ascertained by means of experiments, but we have no principles to guide us so far as the difficulty of words outside this list is concerned. It is even open to question whether or not a word has any intrinsic difficulty. It may be that this difficulty depends entirely on the individual, on the associations that it will suggest at one time or another, on its mode of presentation, and the like.

It has been recognized that sometimes the most "difficult" words are the ones which are better remembered, probably because more effort and attention are given them.

To attempt to equalize the difficulty in an approximate way, we selected for each list, words similar in the following respect:

1. The meaning in English was familiar to the group tested.

2. Each of the lists contained the same number of French words of one, two, three and four syllables. (There were no words of more than four syllables.) The total number of syllables was therefore the same in each list. Moreover, there was a correspondence in the words as to the make up of the syllables, a similar number in each list being composed of consonant and vowel, and another similar number composed of consonant and diphthong. The relative position of these matched French words did not, however, correspond on each list when the test was given.

3. The number of syllables of the corresponding English word was in the majority of the cases the same as those of the French ones; and when this did not occur, at least the number of syllables of the English correspondents were the same.

About the same number of adjectives, verbs and nouns were in each list, although they did not always match each other in the number of syllables.

However, in spite of the care taken, the lists could not be assumed to be of the same difficulty. Therefore, in order to counterbalance any such difference, a very careful rotation of the lists in the experiments was arranged.

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In the experiment of vocabulary learned in associated pairs *vs.* vocabulary learned in context, some context had to be provided. Each list of words was taken, and a sentence for each word was made. The sentence was of such nature as to give either the definition of the word, or to convey its meaning very clearly. These sentences were devised so as to give prominence to the word studied, and care was taken that no other difficult or unknown word was used.

The preparation of this material required considerable labor at the beginning, and in order to supply every possible need for the future, six lists of words were made. This proved sufficient for all our needs.

The Method. The method used in each of these experiments was practically the same. We think that it provided for all necessary control of variables, and obviated, in so far as it is possible, the effect of practice, difference in groups and difference of material. These results were obtained by a careful rotation of groups and tests. Suppose that we were to find out which of four methods would be the best. We would then experiment on four groups with four lists of words. The rotation then would be like this:

Group I		Group III	
List A	Meth. 1	List C	Meth. 4
List B	Meth. 2	List D	Meth. 3
List C	Meth. 3	List A	Meth. 2
List D	Meth. 4	List B	Meth. 1
Group II		**Group IV**	
List B	Meth. 3	List D	Meth. 2
List A	Meth. 4	List C	Meth. 1
List D	Meth. 1	List B	Meth. 4
List C	Meth. 2	List A	Meth. 3

The same material would be studied by all groups. All the lists would be studied by each method, and all four methods would be used by all four groups. But while one group would begin with Method I, another group would begin with Method II, another with Method III, and still another with Method IV. This would tend to equalize the effect of practice.

The same list was studied by the four different methods, so as to obviate the effect of a difference in the difficulty of the vocabulary, and as the methods were rotated, the same

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list was studied once at the beginning, once at the end, and once in the second and third place.

The groups were all chosen among students who had had the equivalent of one year college French. In another experiment, they had the equivalent of eighteen months college French. But the groups were about equal in number and rather homogeneous. However, the fact that each group studied the material by each method removed the effects of any marked difference in the groups.

The only assumption that was made, and it was felt to be a justifiable one, was that the practice effect in one group would about compensate that of the other.

Time. In the first experiment, the amount of time for each method was not constant. We followed the method, still widely used, of studying till a perfect repetition of the material was secured. This is a dangerous mode of procedure, especially if one wants to measure the efficiency of a method not in terms of time but of accuracy. The first procedure, called the " saving method " and first used by Ebbinghaus, measures the efficiency of a method by the time saved in subsequent relearnings, until a perfect repetition is secured. It takes no account of the amount retained. This method has proved very unsatisfactory for the measurement of the efficiency of a given method. The measurement of the efficiency in terms of the amount retained is far superior. We thought we could do both at the same time, and in the first experiment, time was not limited, and the students stopped when they had secured two perfect repetitions of the material. By just sheer luck, the method which proved the most efficient in terms of accuracy, was also the one that took the shortest time. We could then draw some conclusions, but incidentally the defect of the method was not discovered until we made a second experiment, when results were quite different: the best method in terms of accuracy, was also the method that took the longest time. No conclusions could be drawn from the experiment, but a very serious defect of procedure was detected and corrected at once. Thereafter, the time was

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uniform for all methods, and the results were given in terms of accuracy only.

We cannot insist too much on this matter of time, for an inferior method may, if enough time is allowed for the studying, give better results than a superior method with less time allowed for the study. No conclusions can be safely drawn from experiments where the time is variable, if results are to be judged also in terms of amount retained.

The Procedure. The material to be studied was printed on cards and distributed to the students. The lists were turned face downwards.

The first thing done was to explain to the students what they were to study, how they were to study, and what would be the thing asked for in the recall. This was found to be absolutely necessary, as was learned from experience. In one section, the students were not told that in the recall, the English words would be given, and their French associates would be recalled. The result was that half the class had tried to remember the sequence of the words in the list, others had tried to remember the meaning of the French words, while a few had studied for a reproduction of the French words. The experiment had to be repeated, for the results were too poor to be taken into consideration. In fact, it was so remarkable that this will make the object of a further investigation. The students then were warned in advance as to what they were expected to retain and in what way the recall would be asked.

Small slips of paper were distributed with the cards. On these slips each student wrote her name, section, date, and so on. The reverse side of the slip was for writing the words recalled.

In the experiments where time was recorded, the teacher recorded the time at the board every 15 seconds. When a student was through, she recorded on her slip the time last written at the board. It was found that intervals of 15 seconds were small enough for this purpose.

When the time was uniform, the teacher gave the signal to start and the students studied in the manner indicated,

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until told to stop. Care was taken that everybody started and stopped at the same time.

The Recalls. At the time of the recalls, the English words were written on the board, each with a number, and the student was asked to write the corresponding French word. She could omit writing the English word if she wrote its corresponding number in front of the French word. The English words were never written in the same order and the students wrote as many French words as they could remember. They were told not to neglect the accentuation, as such mistakes would be penalized in the scoring.

No time limit was set for the recalls. It was found unnecessary, as everybody was generally through at the same time. The recalls occurred generally after 50 minutes, 2 days, 10 days, and 40 days. These intervals were chosen on purpose. A 50 minute interval was preferred to an immediate recall, for the first big original drop in the forgetting curve is shown to happen during the first half hour. Since the class period lasts only 50 minutes, a recall was taken at the end of the period.

College classes meet generally three times a week or every other day, so that the second recall was after 2 days. An interval of 10 days would be the average interval for reviews according to whether the practice would be to have a weekly or bi-weekly test. The last recall would occur one month after the second recall, or 40 days after the original learning, and would correspond to a monthly review for a monthly test.

It was found also that a certain number of experiments with the forgetting curve were done at intervals of time similar to these, and thereby furnished a nice means of comparison.

Relearnings. In most of the experiments, relearnings took place from time to time. It was feared that if the original learning was somewhat insufficient, the results at the end of 40 days would be so poor as to show very little difference between the methods. The relearnings always took place in the exact manner in which the original learning took place, so that the final results would be a compound of the same

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method. The recall was given first, then the relearning took place immediately afterwards. Printed cards for the relearning, and slips for the recall were distributed at the same time, when both were needed.

The Scoring. The scoring was done in a similar manner for all experiments. A word written correctly was scored three; with a mistake in the accentuation, it was scored two; if a letter was wrong or missing, the word was scored one. For all other errors, the word was scored zero. A correct word had to be in the proper place or with the proper number to get a score. An individual score was the sum of the scores of all the words in the list. A perfect score on any list was 36.

Tabulating the Results. A list was made of all the students who had taken the tests, and before each name was recorded the score and the time (if the time was to be recorded) for the learning and recalls. Any students who had missed either a test or a recall was eliminated, in order that there might be an identical group for the entire experiment. Nobody was allowed to take a test, if it were thought that any circumstance might vitiate the results. A sick student, an upset or tardy one was readily excused. It was felt that a smaller group, under controlled conditions would be more desirable than a larger one with all kinds of variations in the individual performance. As it was, and in spite of all precautions taken, the variability of individual performance was large enough, without the influence of cases of the above mentioned kind.

The results have been tabulated in different ways. The means, S. D. and reliability of average have been calculated for each distribution. In calculating the correlations, the Pearson formula was used.

Every experiment will have, of course, different details of procedure particular to its needs. These will be explained with every experiment. But the main lines of method and procedure as given in this chapter have been adhered to faithfully.

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CHAPTER III

Experiment on the Relative Efficiency of Studying Aloud *vs.* Studying Silently, or Aloud with a Written Recall

The purpose of this experiment was to ascertain the relative efficiency of three methods of studying French vocabulary, i. e., studying silently *vs.* studying aloud or aloud with a written recall.

A great amount of work has been done in kindred matter since the first experiments of Kirkpatrick in 1894.[1] Most of it however has to do with the presentation of the material, either read by the experimenter, or presented to the subject through the slit of a revolving drum. The material, too, has been mostly non-sense syllables, and very little has had to do with foreign vocabulary. Whitehead,[2] Hawkins,[3] Smedley,[4] Henmon,[5] O'Brien,[6] Worcester,[7] and the Germans, Lay,[8] Fuchs and Haggenmuller,[9] and Itschner,[10] were all preoccupied with the presentation of the material. They all found a superi-

[1] Kirkpatrick, E. A.: An Experimental Study in Memory. Psy. Review, Vol. 1, pp. 602-609. 1894.

[2] Whitehead, Louis G.: A Study of Visual and Aural Memory Processes. Psy. Rev., 1896, Vol. 3, pp. 258-269.

[3] Hawkins, Ch. J.: Experiments on Memory Types. Psy. Rev., 1897, Vol. 4, pp. 289-294.

[4] Smedley, C.: Report of Department of Child Study and Pedagogic Investigation. Chicago, No. 3. 1900-1901.

[5] Henmon, V. A. C.: The Relation Between Modes of Presentation and Retention. Psy. Rev., 1912, Vol. 19, pp. 79-95.

[6] O'Brien, F.: A Qualitative Investigation of the Effect of Mode of Presentation Upon the Process of Learning. Am. Jour. of Psy., 1921, Vol. 32, pp. 249-283.

[7] Worcester, D. A.: Memory by Visual and Auditory Presentation. Jour. of Educ. Psy., 1925, Vol. 16, pp. 18-27.

[8] Lay, W. A.: Experimentelle Didaktik. 3d Ed., 1910, pp. 297-305, 351-70.

[9] Fuchs, H., and Haggenmuller, H.: Studien und Versuche Über die Erlernung der Orthographie—Sammlung von Abhandlungen a. a, Gebiete der padag. Psychol. II, 1898.

[10] Itschner, H.: Lay's Rechtschreib-Reform Jahbuch des Vereins für Wissenschaft-Padagogik XXXII, 1900.

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ority of the auditory over the visual. But most of their recalls were oral, a fact that in our estimation has not been given enough importance in weighing the results of these experiments. Smedley and O'Brien, in working the digits, found that the manumotor activity is inferior to both auditory and visual alone.

As for the study of the material where the student either studied silently or read the material aloud, there is the experiment of Von Sybel with non-sense syllables. He found that reading aloud is more favorable to study than silent reading.[11] The experiment was not a group experiment.

Clifford Woody in memorizing poems found that the reading aloud gave better results than silent reading.[12] These last two experiments very similar to ours, were nevertheless different on account of the method and the material used.

Most of these experiments were really laboratory experiments with very few subjects and with a mode of presentation which, because of its scientific accuracy, had to be more or less artificial. In this study, the aim was to experiment on a group and to reproduce as much as possible the normal procedure of students learning some material. Now, when a student has to memorize some material, it is given to him in the form of printed material, to study as he pleases. It is no more a question of presentation of material but one of direct learning. It was necessary therefore to choose among the methods left to the choice of the student, once in the possession of the material to be learned. Either he could study silently, or aloud or write with material. The efficiency of each method was to be measured (a) according to the time it took the students to master the material until two perfect repetitions were secured and (b) according to the number of words recalled correctly. In Chapter II, we pointed out the danger of such a method. But as it worked out all right in this experiment, we have kept the results.

[11] Sybel, Von A.: Über das Zusammenwirken Verschunder Sinnesgebiete bei Gedächtnisleistungen. Zeits. F. Psy., Vol. 53, 1909.
[12] Woody, Clifford: The Effectiveness of Oral *vs.* Silent Reading in the Initial Memorization of Poems. Jour. Educ. Psy., 1922, Vol. 13, pp. 477-483.

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Two repetitions instead of one were chosen for several reasons. First, several delayed recalls were desired, and it was thought that some overlearning was necessary for the purpose. Also, because in ordinary classroom procedure, every competent teacher would insist on a certain amount of over learning. This is what Norsworthy and Whitley[13] say: "The value of overlearning for purposes of recall needs to be impressed on teachers and students. To be able to repeat a thing once without error though it may satisfy a laboratory requirement, does not argue a memory of it in the sense of probable accurate retention. The correctness may be a matter of chance, as every learner discovers 'when trying once.' Consequently, children should be encouraged to learn until they can repeat the material at least twice running without error; which will entail a much greater number of repetitions and effort to recall."

So the students were told to study by the method specified, either silently or aloud or with a written recall, until they could repeat the words twice without mistake.

The material to be studied consisted of lists of twelve English-French words, the French words to be recalled when the English ones were supplied. The recall was written and consequently involved the correct spelling of the words. As Ebbinghaus had noticed a very decided bond between subsequent words in the series, even when one or two were skipped at a time, care was taken to ask for the words every time in a different order. The time taken by the student to master the material up to two perfect repetitions was recorded by each student. In case of a written recall however, the time for the writing of the words was not counted.

Fifty minutes after the first learning, a written recall of the material was asked for, followed by a relearning.

Two days later, another recall of the material was required. Following the recall, a relearning took place, using the method of the original learning.

Ten days later, another recall followed by a relearning took place. Forty days later, the final recall was asked for, but this time, there was no relearning.

[13] Norsworthy and Whitley: Psychology of Childhood, p. 133.

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A group of 81 students (all girls) took part in the experiment. This group was divided into three sections of about the same number of students. All had had the equivalent of one year college French.

The methods, tests, and groups were rotated in the following manner:

Group I	Group II	Group III
List A...Meth. I	List C...Meth. II	List B...Meth. III
List B...Meth. II	List A...Meth. III	List C...Meth. I
List C...Meth. III	List B...Meth. I	List A...Meth. II

Method I will designate hereafter the silent study, Method II the studying aloud and Method III the method with a written recall.

Table I shows the amount retained after an interval of 50 minutes.

TABLE I

Amount Retained After an Interval of 50 Minutes.

	Meth. I (Silent)	Meth. II (Aloud)	Meth. III (Wr. recall)
Total	2195	2387	2404
Average	27.1	29.5	29.7
S. D.	8.0	6.6	7.4
$\frac{(S.\ D.)}{\sqrt{n}}$	.9	.7	.8

The immediate recall shows a distinct inferiority of the first method over the last two. The two last methods are very much alike in their results, the averages being 29.7 and 29.5 against 27.1 for the first method.

Table II shows the results obtained after an interval of 2 days.

TABLE II

Amount Retained After an Interval of 2 Days

	Meth. I (Silent)	Meth. II (Aloud)	Meth. III (Wr. recall)
Total	1838	2144	1899
Average	22.7	26.5	23.4
S. D.	8.9	7.8	8.4
$\frac{(S.\ D.)}{\sqrt{n}}$	.99	.87	.93

The striking fact about these results is the showing of Method III. While it gave the best results after an interval of

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50 minutes, its results after 2 days are almost as poor as those of Method I. Method II shows superior results, the averages being 26.5 for Method II against 23.4 for Method III and 22.7 for Method I.

That an immediate recall does not always give reliable indications as to what may happen in delayed recalls, will be seen more than once in the course of these experiments. Methods which show a superior result for an immediate recall are not always those which show the best results after a certain period of time. The necessity of carrying investigations over a certain period of time is certainly advisable where memory processes are concerned.

Table III, shows the amount retained after an interval of 10 days.

TABLE III

AMOUNT RETAINED AFTER AN INTERVAL OF 10 DAYS

	Meth. I (Silent)	Meth. II (Aloud)	Meth. III (Wr. recall)
Total	1864	2135	1891
Average	23.0	26.3	23.3
S. D.	9.0	7.1	9.2
$\frac{\text{(S. D.)}}{\sqrt{n}}$	1.00	.78	1.0

Method II maintains its superiority, its average being 26.3 against 23.0 for Method I and 23.3 for Method III. It is interesting to compare these results with those obtained after an interval of 2 days. They are almost identical. Later on, we will observe the same fact in other experiments. We must not forget, of course, that a relearning has taken place; but that this relearning will so consistently make up for the natural loss over a period of 10 days is quite remarkable.

Table IV shows the amount retained after an interval of 40 days.

TABLE IV

AMOUNT RETAINED AFTER AN INTERVAL OF 40 DAYS

	Meth. I (Silent)	Meth. II (Aloud)	Meth. III (Wr. recall)
Total	1350	1486	1207
Average	16.6	18.3	14.9
S. D.	9.7	8.9	7.4
$\frac{\text{(S. D.)}}{\sqrt{n}}$	1.0	.97	.80

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The second method maintains its superiority and the third gives the worst results. So that, from the best results in the immediate recall, it nows gives the poorest. These findings are in accordance with the findings of other experimenters, such as Smedley and O'Brien.[14] If the manumotor activity really interferes with the memory, it would be more and more confusing as the intervals between the recalls grow longer. It will be interesting to compare these findings with those of another experiment [15] where a similar shifting occurs in the relative efficiency of methods over a long interval of time.

It was thought to be a desirable thing to tabulate the amount retained after certain intervals, in terms of percentages of the highest possible score. This will enable us to make comparisons with results obtained in other experiments and make possible the graphical representation of the forgetting curves over a period of 40 days.

Table V shows the amount retained in terms of percentage of a perfect score, over a period of 40 days.

TABLE V

AMOUNT RETAINED IN TERMS OF PERCENTAGE OF PERFECT SCORE

	Meth. I (Silent) Per cent	Meth. II (Aloud) Per cent	Meth. III (Wr. recall) Per cent
After 50 minutes	75.3	81.9	82.5
After 2 days	63.1	73.6	65.1
After 10 days	64.0	75.3	64.9
After 40 days	46.3	51.0	41.5

The results, tabulated in this way show probably more clearly the superiority of Method II over the two others. It shows also that the loss is greatest for Method III. For an interval of 40 days, the amount of loss for Method I is 31% of the perfect score, for Method II it is 30.9% while for Method III it is 41%. Methods I and II maintain their difference pretty consistently throughout the recalls.

[14] Smedley, C.—O'Brien, F. J.: op. cit.

[15] See Chapter VIII. On the Relative Efficiency of the Reading *vs.* the Recitation Method of Study.

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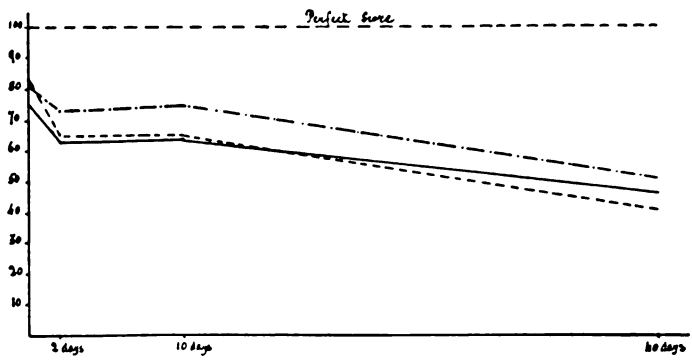
A graphical representation of the forgetting curve for the three processes, in terms of percentages of the perfect score is given in Fig. 1.

Conclusions. When the efficiency of the three methods is tested in regard to accuracy, the results are in favor of studying aloud. Although the method of studying aloud with a written recall proves to be just as efficient for an immediate recall, this superiority disappears quickly, and at the end of 40 days, it proves to be the worst method.

These results would tend to show that the efficiency of a method cannot be ascertained with only one recall, and that it



——— Meth. I (Silent). —.—.Meth. II (aloud).
- - - - Meth. III (Wr. recall).

FIG. 1.—Curve of Forgetting in Terms of Percentages of Perfect Score Over a Period of 40 Days.

is desirable to have both immediate and delayed recalls in experiments of this kind.

Comparing our results with those obtained in others experiments, we found that the amount retained is far superior to those obtained in studies on the forgetting curve. An amount of from 75% to 82% is retained after 50 minutes and at the end of 40 days, there is still retained from 40 to 50% of the perfect score.

There is an original drop during the first 50 minutes in the forgetting curve. That drop is hard to evaluate, although we may assume that the material was perfectly mastered. This drop continues rather abruptly for the first two days, but is very slow afterwards.

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A relearning at the end of 2 days maintains the forgetting curve almost horizontal for 10 days.

Time Tabulations. The unit of time in these tabulations is the quarter of the minute. In Table VI is given the time taken for the original learning by the three methods.

TABLE VI

AMOUNT OF TIME TAKEN FOR THE ORIGINAL LEARNING

	Meth. I (Silent)	Meth. II (Aloud)	Meth. III (Wr. recall)
Total	1621	1632	1376
Average	20.00	20.01	17.00
S. D.	6.0	7.2	4.8
$\frac{\text{(S. D.)}}{\sqrt{n}}$	.66	.80	.53

If we keep in mind the results for accuracy, we see that the third method which gave the highest average is also the one that took the least time. True, the time for the written recall has not been counted here, and will not be in successive recalls. However, omitting the written recall, the learning processes in Methods II and III were identically alike. Yet, the difference in the averages for the time is three points. We will see, later on, more than one illustration of this variability of performance for the same group. The time element being uniform in other experiments, the variability will shows itself in the accuracy. This shows how extremely prudent one must be in the conclusions reached in such experiments, and why it is desirable to have more than one recall or one relearning.

Table VII shows the amount of time taken by the first relearning, 50 minutes after the original learning and immediately after the first recall.

TABLE VII

AMOUNT OF TIME FOR THE FIRST RELEARNING

	Meth. I (Silent)	Meth. II (Aloud)	Meth. III (Wr. recall)
Total	499	422	422
Average	6.2	5.2	5.2
S. D.	3.1	3.0	2.0
$\frac{\text{(S. D.)}}{\sqrt{n}}$	.34	.33	.22

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The remarkable fact about these distributions is the considerable saving of time in the second relearning. When one compares these results to those of Ebbinghaus [16] one finds that there is very little reason to believe that the finding of experiments on non-sense syllables learned in series can be applied to the study of associated pairs. Thorndike [17] says, " The common inference from Ebbinghaus's figures that ½ of the effect of memorizing is lost in less than an hour, and ⅔ in a day is very far from holding true of memory of pairs associates."

This inference was found to be false also in the case of vocabularies learned in series by Professor Cattell.[18]

Ebbinghaus, of course, calculated the loss by the amount of time it took to relearn the series. The distributions above and those which follow, show that time is not as satisfactory a means of measuring the efficiency of a method as accuracy. The time distributions are very compact and the S. D. are very small being 2.0, 3.0, and 3.1 respectively. Individual differences are almost negligible when time is taken as a term of comparison.

Table VIII shows the amount of time taken by the second relearning 2 days after the original learning.

TABLE VIII

AMOUNT OF TIME FOR THE SECOND RELEARNING

	Meth. I (Silent)	Meth. II (Aloud)	Meth. III (Wr. recall)
Total	401	318	324
Average	4.9	3.9	4.0
S. D.	3.5	2.1	2.1
$\frac{\text{(S. D.)}}{\sqrt{n}}$	.37	.23	.23

Method II and Method III have taken practically the same time for the relearning, while Method I has taken a little more time.

[16] Ebbinghaus: Op. cit.
[17] Thorndike, E. L.: Memory for Pairs Associates. Psy. Rev., 1908, Vol. 15, pp. 122-138.
[18] Cattell, J. W.: Op. cit.

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The distributions conserve their typical compactness, and the fact is remarkable when compared with the tendency of the accuracy distributions to flatten and spread more and more. This justifies our contention that accuracy is a more delicate means to measure the efficiency of a method than time, if the experiment is made on a group.

Table IX shows the amount of time taken by the third relearning, 10 days after the original learning.

TABLE IX

AMOUNT OF TIME FOR THIRD RELEARNING

	Meth. I (Silent)	Meth. II (Aloud)	Meth. III (Wr. recall)
Total	480	425	465
Average	5.9	5.2	5.7
S. D.	2.5	2.3	2.0
$\frac{(S.\ D.)}{\sqrt{n}}$	.27	.25	.22

The third relearning after 10 days, takes scarcely any more time than the two others, and the amount of time taken is about the same for the three methods.

Since we tried in this experiment, to find the efficiency of the different methods in regard to both accuracy and time, it has seemed desirable to put together, in the same table, the results obtained in the time and accuracy distribution. Table X gives the averages both for time and accuracy for a period of 40 days.

TABLE X

TIME AND ACCURACY DISTRIBUTIONS FOR THE THREE METHODS

	Time orig. lear.	Accur. after 50 min.	Time first relear.	Accur. 2d rec. 2 days	Time 2d relear.	Accur. 3d rec. 10 days	Time 3d relear.	Accur. 4th rec. 40 days
Silent	20.00	27.1	6.2	22.7	4.9	23.0	5.9	16.6
Aloud	20.01	29.5	5.2	26.5	3.9	26.3	5.2	18.3
Wr. Rec.	17.0	29.7	5.2	23.4	4.0	23.3	5.7	14.9

In the first recall, Method III gives the best results, since the accuracy is the best and the time the shortest. In the second recall, the best showing is made by Method II, the average for accuracy being the best and the time for relearn-

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ing the same as in Method III. In the third recall, the average for accuracy is still higher for Method II although the time for relearning is the shortest. The same thing happens also for the final recall. Of course the time is practically the same for Method II and Method III for all the recalls, but we must not forget that the time spent on writing the list of words in Method III has not been counted, yet this recall was part of the learning process. We may then safely say that Method II took a much shorter time than Method III and yet the results for accuracy are better.

Conclusions. When both time and accuracy are taken into consideration, the method of studying aloud still shows its superiority over studying silently or studying aloud with a written recall.

Time is shown to be a poor basis of comparison when the efficiency of several learning methods is to be ascertained.

Individual differences are far more accentuated in the amount retained than in the time taken for learning or relearning.

The difference between the amount of time taken to relearn the material after an interval of 50 minutes and after an interval of 10 days is surprisingly small.

Results obtained for both time and accuracy after an interval of 2 days are very similar to those obtained after an interval of 10 days.

This experiment confirms what had already been found in other experiments, either with non-sense syllables, or for the mode of presentation alone, i. e., auditory-articulatory-visual memory seems to be the superior method of study. It confirms the opinion of psychologists such as Gordon [19] when she says, " Other investigators find that there is a danger of distraction when three sensory elements are combined, but that two are superior to one."

Correlations. In order to find out whether the students who did well in one method were also those who did well in

[19] Gordon: Educational Psychology, p. 169.

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another, we have calculated the correlations between the accuracy for each of the three methods.

Correlation between accuracy of first method and second = .67
Correlation between accuracy of first method and third = .56
Correlation between accuracy of second method and third = .55

The correlations are all positive and fairly high and show that the students who did well by one process are also those who did well by another. That is to say, there is no such thing as "visual memory" as opposed to "auditive memory," in evidence here, but we see rather that good memories are good whether the learning is done one way or another.

The correlations between the immediate recall and the delayed recall are as follows:

For Meth. I $r = .44$
For Meth. II $r = .37$
For Meth. III $r = .54$

The correlations between the immediate and final recalls are smaller than the correlations between the three processes after 50 minutes. This shows that there is a greater variability in the individual performance in delayed recalls than in different methods of learning. However, the correlations are all positive and fairly high. The highest correlation is found in the poorer process, and the smaller for the best process. We will find this the general rule for correlations between immediate and delayed recalls.

The correlations between the time taken for the original learning are as follows:

Correlation between the time for Meth. I and Meth. II = .55
Correlation between the time for Meth. I and Meth. III = .61
Correlation between the time for Meth. II and Meth. III = .42

These correlations show that the quick learners by one method are also the quick learners by another. These correlations however are rather small and there is evidence of a great variability of performance by the same individual. Consider, for instance, the correlation between Method II and Method III. The processes were identical as far as the time was concerned, since in both instances the study was aloud and the time for a written recall was not taken into consideration. We would then expect, in the repetition of an identical

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performance, by the same group and with the same material to obtain a high correlation. Yet the correlation is actually smaller than the correlation between Methods I and II or between Methods I and III which involved in both cases different performances. Consequently a positive and fairly high correlation is very significant it seems, when individual performances are likely to vary so much from one time to another.

We shall have occasion to see often, in the course of these experiments, that small correlations, as far as rote memory is concerned, are rather the rule than the exception.

Are the slow learners the ones that retain the best, or is the retention of the quick learners superior to that of the slow learners? The following correlations, between the time of learning and the accuracy will answer the question.

Correlations between time of learning and accuracy of the first recall:

Correlation for Meth. I $= -.23$
Correlation for Meth. II $= -.25$
Correlation for Meth. III $= -.39$

The correlations between the time of learning and the amount retained are all *negative*. This shows that the quick learners are not the quick forgetters. To a certain extent, those who learn quickest are also those who retain the best. These findings are in agreement with the opinion of the psychologists. Norsworthy and Whitley[20] say: "The maxim 'easy come easy go' has been firmly fixed with respect to memory. Recent experiments with both children and adults as subjects prove conclusively that the quick learner is not the quick forgetter. Children who learn quickly retain more on the average than those who learn slowly, both as tested by immediate and permanent memory."

Conclusions. From these correlations we may say that:

1. The correlations between the accuracy of the three methods are all positive and fairly high, showing that the students who do well by one method are also those who do well by another.

[20] Op. cit.

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2. The correlations between immediate and delayed recalls, are also positive but not as high as the correlations between the different methods, showing that there is a greater variability of performance in delayed recalls than in different processes of learning.

3. The correlations between the time of original learning for the three methods are all positive and rather high, showing that the quick learner in one method is also the quick learner in the other.

4. The correlations between time and accuracy are all negative but small, showing that the quick learners tend to remember somewhat better.

General Conclusion. In the teaching of foreign languages, more and more is the emphasis placed upon the necessity of teaching the student how to speak the foreign language. This is not an easy task, for pronunciation which requires a very accurate adjustment of muscles is a difficult task in the early stages of language learning. Furthermore, there is according to Handshin [21] "a special hindrance encountered in acquiring a second language, due to the extraordinary resistance of the native speech centers." Watson [22] explains this resistance in saying that "the habitual type of response robs the organism of its muscular flexibility."

To overcome this resistance, much practice is required, for pronunciation is a matter of motor activity as well as auditory perception and memory. Indeed, Palmer [23] goes even farther when he says that "it is impossible to memorize speech material without articulating it in some form or other." Learning a language is then a matter of sensori-motor learning and the question of pronunciation is simply one form of the general problem of how voluntary motions are acquired. According to Freeman [24] "the golden rule of sensori-

[21] Handshin: Method of Teaching Modern Languages, World Book Co., p. 31.
[22] Watson: Talking and Thinking, Behaviorism Lectures in Print. No. X. Peoples Institute Publishing Co., p. 178.
[23] Palmer: The Oral Method of Teaching Languages, World Book Co., p. 21.
[24] Freeman: How Children Learn, Houghton, Mifflin, 1917, p. 142.

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motor learning is much repetition." It follows clearly from the analysis of sensori-motor learning that progress can be gained only through a large amount of practice.

How are the students to get the necessary amount of practice? The time in the class room is limited, and due to the number of students in the class, each one has little opportunity for individual practice. Furthermore, the amount of time devoted to the pronunciation proper is very small Indeed, in the average class room, the course begins with a study of phonetics so that the student may have an idea of the sounds, and that is about all that is done. This is far from being sufficient, for sounds are difficult not only in themselves, but according also to the sounds with which they are associated, and it is only by practicing these combinations that the student will gain the necessary control of his vocal organs. Unfortunately, with the pressure put on the teacher to cover a certain program in so many months, it is difficult to find time for an intermediary stage between the pronunciation of the isolated sounds, and their pronunciation in combinations. This very necessary stage may be supplied to some extent by urging the students to study aloud. However, could the objection be raised that such a practice, excellent for the pronunciation, might not prove to be the most economical way of memorizing foreign vocables? This experiment is the answer to the objection. Its findings are to the effect that studying aloud is the best method and that it has the double advantage of greater accuracy and more persistent retention. When these advantages are added to the undisputed increase in fluency of pronunciation, it is clear that studying aloud is the more advantageous course to follow.

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CHAPTER IV

Experiment on the Relative Efficiency of Studying Vocabulary in Associated Pairs *vs.* Studying Vocabulary in Context

The purpose of this experiment was to ascertain the relative efficiency of studying French vocabulary in English-French associated pairs *vs.* studying the same vocabulary in some kind of context.

A series of twelve English-French words were learned by four different methods. Series A was learned in a list of twelve English-French associated pairs. Series B was learned in a series of twelve sentences, each one containing one of the words to be learned. Series C was learned half in a context and half in associated pairs, and series D was learned half in associated pairs and half in the context. These four different methods will be called Method P, Method C, Method CP and Method PC respectively.

To illustrate the kind of material used and the way it was used, we will suppose that the word 'bit' is to be learned. In series A, the English word will be given with its French associate, 'bit . . . . mors' and studied in this way. In series B, the word will be used in a French sentence, chosen in such a way that the meaning of the word will be made clear by the sentence, thus:

On met le *mors* (bit) dans la bouche du cheval.[1]

Notice that the words in the sentence are all simple, and the meaning easy to ascertain, both of the whole sentence and of the unknown word. The word to be learned was furthermore heavily underlined and its English translation was given immediately after. In Method C the words were studied exclusively in the sentences. In Method P they were studied

[1] The bit is placed in the horse's mouth.

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exclusively in associated pairs. In Method CP, the word was studied half of the time in the sentence, and half of the time in the associated list, in Method PC, the word was studied first half of the time in the associated list, and the rest of the time in the sentence.

The purpose of these different methods was to follow, as closely as possible, the four methods employed most commonly by teachers and in the text-books in presenting the vocabulary. Method P (associated pairs) is the straightforward method which has fallen very much into disrepute among progressive teachers. Method C is the method of acquiring vocabulary entirely through the reading of the text, such as is acquired by the students through their casual reading. The translation of the word in English would represent the searching through the dictionary for the meaning of the unknown word. Methods PC and CP represent the familiar methods used by most of the French grammars. One will have a list of English-French words at the beginning of the lesson and will use these words in a context, the other will on the contrary, first present the words in the context, and study the words afterwards.

It will be well to bear in mind that the objective in this experiment is simply to find the relative value of these different methods as far as vocabulary learning is concerned, and not to consider whether other benefits, real or imaginary, may be derived from one method rather than from another.

One of the objections made to the learning of vocabulary by associated pairs, is that the words learned in this way are useless, inasmuch as the student is often unable to use them in context when he needs them. It was then important to ascertain whether this was true or not. By the same reasoning, it was also important to find out whether the words learned in context could be remembered independently of this context. This experiment, like the others, dealt exclusively with the active knowledge of vocabulary.

In order to find out whether words studied in context could be remembered separately from the context, and whether

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words studied in pairs could be used in a context, there were two recalls. In one recall, the student was given the list of English words, and their French associates was asked for. In the second recall (following immediately after the first one) the French sentence would be written at the board, with the word studied missing and replaced by its English translation. The student was asked to replace the French word in the sentence.

Through a slight error in procedure, the recalls were always given in the same way, i. e., the recalls by pairs always preceded the recalls in sentences, so that the recall in the context did benefit from the first recall; furthermore, the sentences used in the original learning were the same as those used in the recalls. We did not want the recall by context to influence the recall by pairs, but by doing so, the procedure benefited the recall by context. A rotation in the procedure could have taken care of this but was not thought of at the time. However the results were such, that in spite of these advantages, the recall most benefited was still the poorest in its results, and we could draw safely our conclusions.

Very little work has been done on this particular subject. W. J. Grinstead[3] tested the associational influence of context in fixing the meaning of new words encountered. He read the words in a German context and when an unknown word would present itself, he would look for its meaning in the dictionary. On the other hand, words given in a formal list were also looked up in the dictionary. He found that in the recall the words encountered in the context were remembered better. This experiment however cannot be taken as conclusive, since it was only with one individual and no control of any sort was resorted to.

The Group Tested. A group of sixty college students in second year French participated in this experiment. The group was divided into four sections of about the same number of students.

[3] Grinstead, Wren J. An Experiment in the Learning of Foreign Words. Jour. of Educ. Psy., 1915, Vol. 6, pp. 242-245.

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Rotation of Lists and Methods. In order to counterbalance the possible effects of practice, methods and lists were rotated in the following way:

Group I		Group III	
List A	Meth. P	List C	Meth. CP
List B	Meth. C	List D	Meth. PC
List C	Meth. PC	List A	Meth. C
List D	Meth. CP	List B	Meth. P
Group II		**Group IV**	
List B	Meth. PC	List D	Meth. C
List A	Meth. CP	List C	Meth. P
List D	Meth. P	List B	Meth. CP
List C	Meth. C	List A	Meth. PC

The Experiment. Printed lists were distributed to the students. They were requested to study them aloud for 9 minutes. The sentences were to be read in their entirety every time they wished to repeat the word to be learned. They were warned in advance that there would be a recall, and in what manner that recall would be given. In the case of the mixed methods (half sentence and half pairs) the students were given the two texts, and at the end of 4½ minutes changed quickly from one to another. As the students were prepared for such a change, it took scarcely more than 1 or 2 seconds to do it. At the end of 9 minutes, the texts were collected and the class work resumed.

The first recall was made at the end of 50 minutes. The English words or the French sentences were written on the board in a different order from that of the printed lists. The students had two slips of paper. On the first they wrote the French associate of the English word, on the other they wrote the missing French word of the sentence. They were warned not to make any alteration of the first slip, should they happen to recall something more in the following recall.

Time of Learning. There was to be no relearnings, and it was thought that a certain amount of overlearning would be desirable to carry the material over a period of 40 days. Taking the time of a previous experiment as a basis, we chose 9 minutes for the initial learning.

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The recalls were made at respective intervals of 50 minutes, 2 days, 10 days, and 40 days.

Tabulating the Results. For each experiment, we had two sets of recalls, one for the words asked for in the context, the other for the words in associated pairs. The first recall will be called C and the second P. It is well to have in mind that the P recall always preceded the C recall.

TABLE XI

AMOUNT RETAINED AFTER 50 MINUTES

	Meth. P		Meth. PC		Meth. CP		Meth. C	
	Pairs	Context	Pairs	Context	Pairs	Context	Pairs	Context
Total	2009	2004	1860	1865	1904	1900	1690	1717
Average	33.5	33.4	31.0	31.1	31.7	31.6	28.2	28.6
S. D.	3.84	4.2	5.61	5.49	5.13	5.31	7.62	7.35
$\frac{\text{(S. D.)}}{\sqrt{n}}$	.49	.54	.73	.71	.66	.68	.98	.95

This table shows that the method of learning vocabulary by associated pairs gives the best results of the four methods. The learning in the context gives the poorest results, while the mixed methods give intermediary results, very similar to each other. The superiority of the method of associated pairs is quite marked, the average being 33.5 against 28.2 for the method by context. It is also interesting to notice how similar are the results for the two successive recalls, although the recall by pairs was always given first. The only case where the results are somewhat dissimilar, is in the method by context, which would tend to show that while the words learned by pairs are readily enough used in a context, the transfer from the context to the associated pairs is not so easy. However, the difference is very small in all cases, and we can say safely that whoever learned a word by the method of associated pairs could use it readily in a context and vice-versa.

The S. D. of the distributions being very small, the averages are quite reliable as far as the number of students is concerned.

The character of the distributions is also very interesting. The distributions for the recall of Method P shows a great

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number of perfect scores, in fact ⅔ of the total number of scores, while only ⅓ made a perfect score in Method C and ½ made a perfect score in the mixed methods. The S. D. of the P. distributions are remarkably small.

The graphic representations for the two recalls are very much alike in character, although the recall in the sentences is slightly superior to the other. That it does not show any more superiority is rather surprising considering that the recall by context came after the recall by pairs, and that the same sentence was used all the time.

Table XII gives the means and S. D. of the accuracy distributions for all methods and both recalls, after an interval of 2 days.

TABLE XII

ACCURACY DISTRIBUTIONS AFTER AN INTERVAL OF 2 DAYS

	Meth. P		Meth. PC		Meth. CP		Meth. C	
	Pairs	Context	Pairs	Context	Pairs	Context	Pairs	Context
Total	1898	1904	1717	1729	1715	1721	1688	1714
Average	31.6	31.7	28.6	28.8	28.6	28.7	28.1	28.6
S. D.	4.95	5.58	6.15	6.42	5.91	6.90	6.96	6.51
$\frac{\text{S. D.}}{\sqrt{n}}$	.64	.72	.79	.82	.76	.89	.89	.84

The method of learning by associated pairs maintains its marked superiority after an interval of 2 days. The respective averages being 31.6 and 31.7 against 28.1 and 28.6 for the method of learning by context. We must note, however, that the loss for the C method is almost negligible while the average for the P method has dropped from 33.5 and 33.4 respectively to 31.6 and 31.7. The showing of the mixed methods is interesting. Their averages, which were superior to the average of the C method in the first recall, have now dropped to the level of the average of the C method.

Let us note also the very small superiority of the second recall (C recall) to the first recall (P recall) in Table XII.

The distributions, still very compact for Method P widen from Method P to Method C. The distributions for the last three methods are strikingly similar. The P method shows the greatest number of perfect scores, especially in the C

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recall. This difference of perfect scores in the two successive recalls shows that a second recall, while insufficient to add any more words, would probably tend to correct small mistakes in spelling or accentuation, thus changing the score from one to two points.

Table XIII gives the results for the recall after an interval of 10 days, for both P and C recalls.

TABLE XIII

ACCURACY DISTRIBUTIONS AFTER AN INTERVAL OF 10 DAYS

	Meth. P		Meth. PC		Meth. CP		Meth. C	
	Pairs	Context	Pairs	Context	Pairs	Context	Pairs	Context
Total	1915	1910	1693	1701	1713	1716	1647	1657
Average	31.9	31.8	28.2	28.3	28.5	28.6	27.4	27.6
S. D.	4.83	4.92	7.02	6.90	6.78	6.75	7.35	7.11
$\frac{\text{(S. D.)}}{\sqrt{n}}$	.62	.63	.90	.88	.87	.87	.94	.92

The method of associated pairs is still superior, the average for the recalls being 31.9 and 31.8 against 27.4 and 27.6 for the context method. The most striking fact about these results is that they are almost identical to the results obtained after an interval of 2 days. Method P shows a very slight increase. No relearning took place between the original learning and these recalls. On other experiments when a similar fact occurred, we attributed it to the fact that a relearning had taken place between the two recalls. But such does not seem to be the case. Method C shows the poorest results, and it is remarkable to see how the results of the mixed methods follow each other so closely.

Table XIV gives the results for the recalls after an interval of 40 days.

TABLE XIV

AMOUNT RETAINED AFTER AN INTERVAL OF 40 DAYS

	Meth. P		Meth. PC		Meth. CP		Meth. C	
	Pairs	Context	Pairs	Context	Pairs	Context	Pairs	Context
Total	1493	1552	1316	1350	1324	1398	1247	1290
Average	24.9	25.5	21.9	22.5	22.0	23.3	20.8	21.5
S. D.	7.50	7.35	7.50	7.26	7.95	7.89	8.01	7.89
$\frac{\text{(S. D.)}}{\sqrt{n}}$	.97	.94	.98	.93	1.02	1.01	1.03	1.02

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After an interval of 40 days, the results remain consistent with those of earlier recalls. The method by associated pairs is still superior by a tangible amount to the method by context, the averages being 24.9 and 25.5 against 20.8 and 21.5 respectively. The mixed methods, however, have regained somewhat and stand in the middle ground just as they did after the first recall.

There is a constant improvement in the second recall (C recall) over the first recall (P recall). It is the first time that we observe any noticeable improvement. Whether this is due to the fact that a second recall will always be better than the first, or because, the sentence has helped in the recall we have no way of ascertaining. Judging from the results of the other recalls however, where the sentence did not help at all, we are inclined to attribute the difference to the fact that the C recall came in the second place.

Percentages. If we interpret the results into percentages of the perfect scores, the results will be clearer. The maximum score is 2160 and the amount retained is given in Table XV.

TABLE XV

AMOUNT RETAINED IN PERCENTAGES OF THE PERFECT SCORE

	Meth. P		Meth. PC		Meth. CP		Meth. C	
	Pairs Per cent	Context Per cent	Pairs Per cent	Context Per cent	Pairs Per cent	Context Per cent	Pairs Per cent	Context Per cent
1st Rec.	93.01	92.78	86.12	86.35	88.15	87.97	78.25	79.50
2d Rec.	87.88	88.15	79.49	80.05	79.40	79.68	78.16	79.40
3d Rec.	88.66	88.43	78.38	78.75	79.40	79.41	76.25	76.72
4th Rec.	69.13	70.93	60.94	62.50	61.30	64.73	57.74	59.73

The results show that the amount retained after 50 minutes by the P method is 93.01% and 92.78% of the perfect score while it is 78.25% and 79.50% of the perfect score for the C method. In other words, the P method surpasses the C method from 14.76% to 13.28% of the perfect score.

Comparing the results after 40 days, we find that the method of paired associates gives results superior to the

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method of context by 11.20%. This superiority maintains itself through all the recalls. Another remarkable fact about these results is that all the recalls are so consistent with the original recalls and with each other. Roughly speaking, there is for every method a loss of about 20 to 25% of the perfect score between the immediate recall and the final recall after 40 days.

There is also a remarkable consistency between the two consecutive recalls (P recall) and (C recall). Nowhere is there seen a superiority marked enough to attribute it to other causes than to the very natural improvement that a second recall would show over the first. Warner Brown[1] says, "A second recall contains more items than the first, because repetition tends to fix the items of the first recall, while chance tends to introduce new items into the second recall, in addition to those retained from the first recall." We did expect, however, that the sentences would help in the recall of words not recalled by the sight of the English associate, but evidently there is not a trace of such improvement.

A glance at the percentage of the perfect scores for the recalls at the end of 2 days and at the end of 10 days, will show how strikingly similar they are. Also, the amount retained by all methods is unusually high. Compared with results obtained by other methods, and for a similar time, we will see later that they are the highest obtained. It is true that the original time of learning was 9 minutes. But as there were no relearnings, it is no more than the average time taken in most of the experiments done in this work. Thus it would appear that given a certain amount of time for learning, it is more advantageous to spend it all in the original learning and have no relearnings, than to spend part of it on subsequent relearnings.

[1] Warner Brown: Effects of Interval on Recalls. Journal Exp. Psy., 1924, Vol. 7, pp. 469-474.

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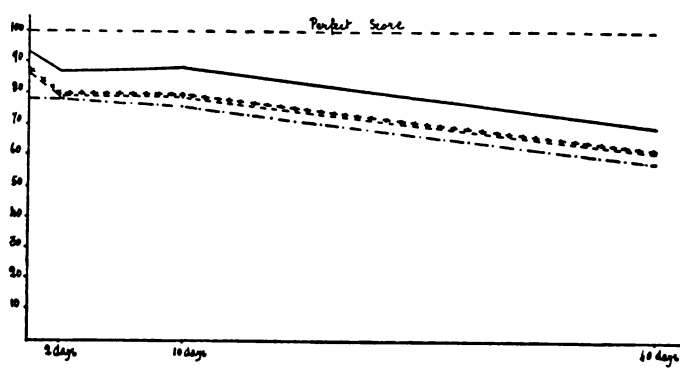
Fig. 2 represents the curve of forgetting for the four methods over a period of 40 days.

These curves are very similar to the curves obtained in the experiment of Chapter IV. The parallelism of the lines illustrates the consistency of the results. Let us note, however, that the curve for the method of studying words in a context does not present the original drop as in the others. This is quite an exceptional curve in this respect. Let us notice also the almost horizontal line between the second and tenth days recalls.



——— Meth. I (P). - - - - Meth. II (PC). + + + + Meth. III (CP). —.—. Meth. IV (C).

FIG. 2.—Curve of Forgetting in Terms of Percentages of Perfect Score Over a Period of 40 Days.

Conclusions. The method of learning the vocabulary by associated pairs is superior to the method of learning it through a context or by a mixed method.

That superiority is very marked both for the immediate recall and for the delayed recall.

The method of associated pairs gives a great number of perfect scores, in fact ⅔ of the total as against ⅓ for the context method in a recall 50 minutes after the original learning.

When two consecutive recalls are made, the second, contrary to expectation, is very little superior to the first. The

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only case where any noticeable superiority occurs is in the final recalls, after an interval of 40 days.

There is a marked similarity in the results obtained after an interval of 2 days and of 10 days, although no relearning has taken place.

An amount varying from 93 to 69% of the perfect score is retained after 50 minutes, and from 79 to 59% of the perfect score is retained after 40 days; this is in our estimation an unusual amount.

Correlations. We have calculated the correlations between the accuracy for each method (P recall) after an interval of 50 minutes. The results are as follows:

Correlation between Meth. P and PC = .50
Correlation between Meth. P and CP = .59
Correlation between Meth. P and C = .35
Correlation between Meth. PC and CP = .44
Correlation between Meth. PC and C = .50
Correlation between Meth. CP and C = .73

The correlations are all positive and fairly high except for Method P *vs.* Method C. It is to be noted however, that only seven students out of sixty did actually better by Method C than by Method P, according to the distribution diagram (steps of three units) and out of the seven, four made scores which differed by one step only (three units). The correlation between CP and C is the highest.

The correlations between immediate and delayed recalls are as follows:

For Meth. P = .49
For Meth. PC = .61
For Meth. CP = .50
For Meth. C = .56

The correlations are all positive and rather high. Compared with those obtained in Chapter IV, they tend to show that these relatively higher correlations may be due to the fact that the amount retained in the final recall was so much more in this experiment than in the other. This matter will be discussed later when results will be given for correlations between immediate and delayed recalls for all experiments.

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However, we may remark that the correlations between immediate and delayed recalls are as high as the correlations between the immediate recalls for the different methods of learning.

General Conclusion. It may be safely concluded that the method of learning vocabulary by associated pairs is by far the most superior of the four methods tried in the experiment. This superiority maintains itself through a period of 40 days and for several recalls.

These results are by no means in accordance with the modern creed for the teaching of foreign vocabulary. There are schools which will not allow the use of any English at all in the teaching of a foreign language. In the reaction against the old methods of teaching foreign languages, we have gone so far as to discard everything, the good and the bad. However, a healthy reaction is beginning to be seen. Assertions made without the shadow of a proof or on the finding of "scientific" experiments which could not support scrutiny are beginning to be challenged. It is really comforting to see men like Palmer [4] taking the courageous stand of giving each its proper due. Without denying the real advantages of the direct method, he says, "The exclusion of translation as a regular means of conveying the meaning of units is an uneconomical and unnatural principle."

Whatever may be said for the advantage of presenting the vocabulary in context, and there is much of course, still when it comes to memorizing the words as such, the method of associated pairs is the best. These results seem to justify the psychological law of specific learning. Learning is made of an infinite number of small reactions which combined give a more complex reaction. The smaller the bond to remember, the better and quicker it will be remembered. Gates [5] says, "One must learn precisely the reactions that will be needed for practical purposes." It is evident that in using a word in a thousand possible combinations, the reactions obviously are

[4] Palmer. The Scientific Study and Teaching of Languages, p. 93.
[5] Gates: Psychology for Students of Education, p. 269.

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limited in every case to the meaning of the word, and the context in which it was originally learned quickly fades out. Then why learn it at first?

In this experiment, when the students were warned in advance of the bond they were to remember, the presence of a text had very little influence; on the contrary, it proved to be a handicap in the formation of the bond between the English word and its French associate. That the students were able to use a word learned by the translation method in a context which they had not seen previously, answers the objection very often put forward that words learned that way are useless since the students are unable to use them when needed.

That the associations of a word with the context will help to strengthen the bond has also proved a fallacy.

This, of course, does not by any means imply that the study of the vocabulary in context ought to be avoided. It is perfectly evident that something very valuable is gained by such a process. For instance, there are words that cannot be satisfactorily translated by another word. If a word has several meanings, a sentence to illustrate each meaning is also desirable. But the question discussed here is not of the superiority of one method over the other *in toto*. It is specifically this: Given a certain number of French words to be studied to the extent of being able to give them either in a sentence or alone when the English word is given the best method of study is that of associated pairs.

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CHAPTER V

On the Relative Efficiency of Studying a List of English-French Words by the Whole *vs.* the Part Method

The purpose of this experiment was to ascertain the relative efficiency of learning a list of twelve English-French words by the whole *vs.* the part method.

A list of twelve English-French words being given, the purpose of the experiment was to find whether we could obtain different results by studying one pair, four pairs, six pairs or twelve pairs at a time. It was also the purpose of this experiment to find out whether the vertical bond formed in studying the words in series would interfere with the horizontal bond, and if so, in what way.

It must be remembered that the object of the learning was not to remember a series in the order given, but on the contrary, the recall was exclusively that of one associated pair at a time, and these were always given in the recalls in a different order from the original list.

A certain amount of research has been done on the whole *vs.* the part method of learning, but the experiments have been somewhat different from this one, and it is difficult to think that the results obtained could reasonably be applied to this particular problem.

W. H. Pyle and J. C. Snyder,[1] Mary Lakenan,[2] and Larguier des Bancels,[3] found that for the memorizing of poetry, the whole method was more economical than the part method.

[1] Pyle, W. H., and Snyder, J. C.: The Most Economical Unit for Committing to Memory. Jour. Educ. Psy., 1911, Vol. 2, pp. 133-142.

[2] Lakenan, Mary: The Whole and Part Method of Memorizing Poetry and Prose. Jour. Educ. Psy., 1913, Vol. 4, pp. 189-198.

[3] Larguier des Bancels: Sur les Méthodes de Mémorisation, Année Psychologique, 1902.

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For comprehensive prose, Lakenan found that the whole method was superior to the part method while Reed[4] found that both methods are of about the same value. Reed found that for poetry, the part method is superior.

Warner Brown[5] in 1924 made an experiment very similar to this one. He took a list of twelve pairs associated, English-nonsense syllables. The lists were exhibited to the class and read aloud. In one method, each pair was read to the class separately twelve times, in another method the whole list was read to the class twelve times. He found that the whole method gave better results than the part method.

Our experiment was devised somewhat on the same lines. The material was different, the nonsense syllables having been replaced by French words, and instead of having the material read to the class, the students studied the material themselves. Moreover, the experiment was divided into four parts, that is, the students studied the lists one pair at a time, four pairs at a time, six pairs at a time, and twelve pairs at a time. The recalls also were extended over a period of 40 days, since experience had shown that an immediate recall is not always sufficient in ascertaining the merit of one method as compared with that of another.

Four methods of study were devised. In the first method, the students took one associated pair at a time and read it six times; in the second, they took four pairs at a time and read it six times; in the third, six pairs were to be taken at a time and read six times, and finally the whole list was to be read entirely six times.

That the whole method would show its superiority on material such as prose, poetry or series which have to be memorized in serial order is quite reasonable to expect. But, in this case, where a separate bond is required, the contrary

[4] Reed, M. R.: Part and Whole Method of Learning. Journal Educ. Psy., 1924, Vol. 15, pp. 107-115.

[5] Brown, Warner: Whole and Part Method in Learning. Journal Educ. Psy., 1924, Vol. 15, pp. 229-233.

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seems the logical alternative. This is what Gates* in his Psychology for Students in Education says:

> Consider the learning of a vocabulary which is given in the book as follows:
>
> 1 Der Mann—The man.
> 2 Der Knabe—The boy.
> 3 Der Hund—The dog.
> 4 Das Haus—The house.
>
> Suppose that the child learns the vocabulary by reading the pairs one after another in the order given. What connections are formed? Bonds between the pairs and their positions in the series are made, and are specially strong in the case of the beginning and end of the list. Thus Der Mann is connected with its firstness, Der Knabe with secondness, etc. Bonds between the first pair and the second pair, the second and third pairs, etc., that is, serial connections between the end term of a pair and the beginning of the next (man—Der Knabe, and boy—Der Hund) and between the various end terms (man—boy—dog) are also established. Learned in a list a great number of such connections are made and it is upon these that the reaction may largely depend. Now, suppose you ask the boy to give the equivalent of "house" or suppose Der Hund is written on the board. He may fail to make the correct responses in both cases, although he could say the whole list as he learned it. It is something like asking an adult to give immediately the letter which preceded q or o; unless he has previously practiced just such reactions, he must get the answer in some round-about way.
>
> One must learn precisely the reaction that will be needed for practical purposes. Ordinarily, we study the German-English vocabulary so that later on seeing the German word in isolation or in various contexts, we can react with the thought of its English equivalent. A good method of learning, then, would be to take small cards and to write on one side the German word, on the other the English. Shuffle several such cards in order to avoid forming serial position and other irrelevant bonds. Look at the German word and try to recall the English equivalent. This demands the reaction that one will later be called upon to make.

This opinion seems to be contrary to the findings of Warner Brown. However, it is so logical, every argument is so convincing, that one is ready to accept it, were it not that the experiments already made seemed to point in the other direction. It was because the findings of Brown on one hand and the stand of Gates on the other were somehow conflicting, that we began this experiment, choosing the very material indicated by Gates.

A group of forty-four students participated in this experiment. They were divided into three sections of about the same number and same training in French (second year college French).

*Gates: Psychology for Students in Education, p. 268.

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The lists of words were those used in a previous experiment and groups, lists and methods were rotated in the following way:

Group I	Group II	Group III
12 words..List I	6 words..List IV	1 word...List II
6 words..List II	1 word...List III	4 words..List IV
4 words..List III	12 words..List II	6 words..List I
1 word...List IV	4 words..List I	12 words..List III

It was decided that the lists should be studied aloud, a previous experiment having shown the superiority of this method. Each pair or group of pairs was to be repeated aloud six times. That number of repetitions was chosen for the sake of comparison with another experiment. It must be noted however, that in choosing that number of repetitions, we would by no means secure a perfect learning of the material. To read the material took about 3 minutes while the average time for securing a perfect mastery of the material as found in another experiment was 6 minutes.

Procedure. A printed list of twelve English-French words was given to the students. They were told to study in the manner indicated, but were warned in advance that the horizontal bond was the one to remember, and that the English words would be given in the recall but in a different order.

Then the study began. The cards were turned right side up and the words read aloud in a sort of rhythmic way at an even speed (30 seconds for the list). The students were told to *read* during the whole process of learning to obtain more uniformity. When the list was read in parts, in order to prevent the eyes from wandering from one part of the list to another, a card was used to conceal the part not studied at the time.

The students did not have to worry about counting the number of repetitions. The teacher counted them, and at the end of the sixth, gave the signal to pass to the next pair or next group of pairs. At the end of the study, the cards were turned over and the class-work resumed.

At the end of the class period (50 minutes) a recall took place. There were other recalls at the end of two days, 10 days, and 40 days. No relearning took place after the recalls.

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For the recalls, the English words were written on the board in a different order in every recall. As Ebbinghaus found that a bond is formed between members of series, even when you skipped two or three syllables at a time, the list was generally worked from the bottom up, skipping one or two pairs at a time.

The tests were scored in the usual manner and the results tabulated.

Table XVI gives the results for the amount retained after an interval of 50 minutes for the four methods. For convenience, we will call the method of studying one pair at a time Method I, four pairs at a time Method II, six pairs at a time Method III and twelve pairs at a time Method IV.

TABLE XVI

AMOUNT RETAINED AFTER AN INTERVAL OF 50 MINUTES

	Meth. I (1 pair)	Meth. II (4 pairs)	Meth. III (6 pairs)	Meth. IV (12 pairs)
Total	561	618	699	785
Average	12.7	14.04	15.98	17.84
S. D.	6.8	8.36	7.6	7.2
$\frac{(S.\ D.)}{\sqrt{n}}$	.97	1.27	1.15	1.09

The table shows that for an immediate recall, the whole method is far superior to the part method, the average being 17.7 against 12.5. Moreover, there is an extremely interesting gradation in the results as the parts studied become longer and longer. One pair at a time gives an average of 12.7, four pairs at a time gives an average of 14.04, six pairs at a time shows an average of 15.98 and twelve pairs at a time shows an average of 17.84. In the presence of such a consistency in the results it is difficult to attribute it to an element of chance. We may at the same time notice that the amount retained does not reach anything like the amount retained in the previous experiment. This presents an interesting field of comparison that may be discussed later on.

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Table XVII gives the results for the amount retained after an interval of 2 days (no relearning has taken place).

TABLE XVII

AMOUNT RETAINED AFTER AN INTERVAL OF 2 DAYS

	Meth. I (1 pair)	Meth. II (4 pairs)	Meth. III (6 pairs)	Meth. IV (12 pairs)
Total	489	527	540	738
Average	11.11	11.97	12.27	16.77
S. D.	7.28	7.62	8.02	6.72
$\frac{\text{(S. D.)}}{\sqrt{n}}$	1.1	1.15	1.21	1.01

The superiority of the whole method is still maintained after an interval of 2 days. The average is 16.77 against 11.11, quite a marked superiority. The Methods II and III do not, however, maintain their place midway between the two other methods, but their average is now nearer the average of Method I.

Table XVIII gives the results for the amount retained after an interval of 10 days.

TABLE XVIII

AMOUNT RETAINED AFTER AN INTERVAL OF 10 DAYS

	Meth. I (1 pair)	Meth. II (4 pairs)	Meth. III (6 pairs)	Meth. IV (12 pairs)
Total	466	452	414	640
Average	10.5	10.27	9.45	14.54
S. D.	6.90	7.04	7.12	6.54
$\frac{\text{(S. D.)}}{\sqrt{n}}$	1.04	1.06	1.07	.97

While the whole method maintains its superiority over the part method its average being 14.54 against 10.5, it is interesting to note that the intermediary methods give no worse results than the method of studying one pair at a time. The loss over a period of 10 days is very small although no relearning has taken place.

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Table XIX gives the amount retained after an interval of 40 days.

TABLE XIX

AMOUNT RETAINED AFTER AN INTERVAL OF 40 DAYS

	Meth. I (1 pair)	Meth. II (4 pairs)	Meth. III (6 pairs)	Meth. IV (12 pairs)
Total	322	289	282	457
Average	7.31	6.56	6.40	10.38
S. D.	5.92	4.38	5.12	5.98
$\frac{(S.D.)}{\sqrt{n}}$	.89	.66	.77	.89

The same phenomena that we have been observing in the last two recalls is reproduced here in a more marked way. The intermediate methods have fallen far behind Method I, while Method IV maintains its superiority. The average for the whole method is 10.38 against 7.31 for Method I and 6.56 and 6.40 for the intermediate methods.

These results have been interpreted in terms of percentages of the perfect score. Table XX shows the amount retained over a period of 40 days by the four methods, in terms of percentages of the perfect score.

TABLE XX

AMOUNT RETAINED IN TERMS OF PERCENTAGES OF THE PERFECT SCORE

	Meth. I (1 pair) Per cent	Meth. II (4 pairs) Per cent	Meth. III (6 pairs) Per cent	Meth. IV (12 pairs) Per cent
1st Recall	35.41	39.01	44.12	49.49
2d Recall	30.87	33.27	34.09	46.59
3d Recall	29.42	28.53	26.13	40.44
4th Recall	20.32	18.24	17.80	28.85

In this form, the results are somewhat clearer. After an interval of 50 minutes, the amount retained by the whole method is roughly 50% of the perfect score, against 35% for the part method. The intermediate methods show a retained amount of 39% and 44% of the perfect score respectively. This means that the difference between the two extreme methods is roughly 15% of the perfect score.

Comparing these results with those obtained after 40 days, we find that the whole method is still superior by 9% over

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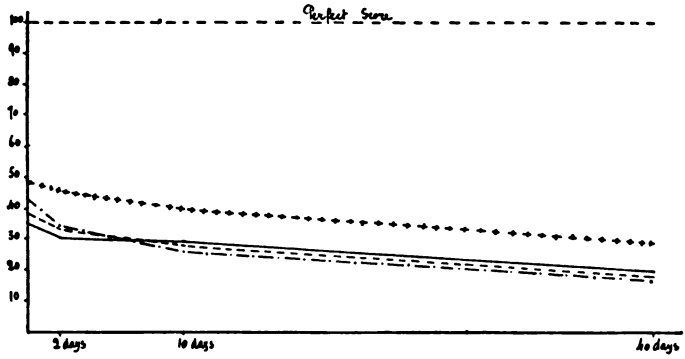
the part method. There is great consistency in the results of the recalls compared with the original learnings for the two extreme methods. But the two intermediate methods show a more accentuated loss which slowly displaces them from their intermediate place to the last place.

This fact emphasizes again the necessity of having delayed recalls to ascertain the true value of a method. If we recall the experiment in Chapter IV, a similar displacement was observed for the intermediate methods.



——— Meth. I (1 pair). - - - - Meth. II (4 pairs).
—.—.— Meth. III (6 pairs). ++++ Meth. IV (12 pairs).

FIG. 3—Curve of Forgetting in Terms of Percentages of Perfect Score Over a Period of 40 Days.

The loss for Method IV over a period of 40 days is about 15% while the loss for Method I is 20% of the perfect score.

Fig. 3 represents the forgetting curve for the four methods over a period of 40 days.

The indisputable superiority of Method IV appears clearly in these curves. Compared with the other curves of forgetting already obtained (Fig. 5 and Fig. 18) the similarity of phenomena is remarkable. The parallelism of the best and worst curve, the breaking down of the intermediate method, the closeness of the curves representing Methods I, II and III, all these facts recurring in so remarkable a fashion ought to

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attract our attention, when the forgetting curves will be studied later on.

Conclusions. The results in this experiment are clear cut: The part method of studying a list of pairs associated is markedly inferior to the whole method, if the formation of the bond between the two members of the associated pair is the bond that we are trying to form.

The intermediate methods (four pairs at a time and six pairs at a time) while giving intermediate results after an interval of 50 minutes, do not maintain their medium place but already at the end of 10 days show poorer results than the part method of one pair at a time. This inferiority is still very marked at the end of 40 days.

An immediate recall is insufficient to show the superiority of any method over another.

Individual differences in memory are best ascertained when there has been no overlearning of the material. These differences disappear either when there has been too much or too little study.

Although no relearning took place after the original learning, Method IV shows a very slight drop after 2 days, and Method I shows practically no loss in the interval from 2 days to 10 days.

Discussion of the Results. Just how are we to reconcile these results with the stand taken by psychologists? That bonds are formed in every direction when the words are studied in the list, instead of separately, is absolutely true; and that they must interfere is also evident. If then, the results are still in favor of this method, it must be because something happens either to nullify this interference, or to nullify the apparent advantage of the part method. We are inclined towards the latter theory. We believe, when the list is studied in part that there is some kind of unconscious distraction disturbing the mind and which leads to confusion and bad results.

Let us try to explain what may have taken place. When the student reads each pair separately six times, his attention is

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shifted from one kind of bond to another every 15 seconds. This means, that every 15 seconds, the bond that he is attempting to make is broken, a new setting and a new orientation of the mind is required, together with the inevitable distraction of passing from one pair to another. How much is lost in this shifting and readjustment is difficult to estimate.

Now when the whole list is read at a time, there are twelve different bonds to be formed it is true, but they come serially, without interruption, like one big continuous bond. At the end of 30 seconds, there is one readjustment to begin the list anew and no change for another 30 seconds. On a total of 3 minutes study, the amount lost by this readjustment would be twice as great for the part method as for the whole method.

Let us take the group of four pairs at a time. To begin with we did not have the words written in separate groups of four or six pairs, but it was the list of twelve pairs that was artificially divided in groups of four or six pairs. There was necessarily some confusion at the parting of the imaginary line which divided one group from the other. Furthermore, the students were instructed to put a card on the part already studied. This took time, was distracting, and may have affected the learning. This disturbance occurred three times at intervals of 60 seconds and furthermore, the students had to readjust their vision every 10 seconds when they began to read the group anew.

The same thing happened with the group of six pairs at a time, the study of the group lasted 90 seconds with a readjustment every 15 seconds for the vision and a greater disturbance when a new group was begun.

We believe the explanation of the phenomena rests in the time lost and the distraction of the mind during these readjustments. Furthermore, the students although relieved of the necessity of counting the number of repetitions kept count unconsciously and made ready for a change before the time came. There may also have been a lingering on of the old bond, while the new one was being formed. All these distrac-

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tions would of course be the more numerous as the changes would take place oftener. It is perfectly possible, if a longer period of learning had been allowed, say twelve repetitions instead of six, that the time lost by these multiple readjustments would have had relatively less importance, and the results may have been quite different. If they were, this would be a justification of the theory advanced here.

The problem, although the results seem conclusive enough, is far from being solved. Another experiment with a certain amount of over-learning as indicated above would be desirable. Another, with the groups distinctly separated is also desirable. It may be that all the confusion comes from the fact that the grouping was not done in the list. But more important than that although closely related to it, is the question of the maximum number of words to be studied at a time. Did the study of twelve words at a time give better results because that was the whole list, or because the more pairs there are the better one learns them? If so; what is the optimum number of words that can be most satisfactorily studied at a time? It is hard to believe that the number twelve chosen at random has anything to do with the fact that a list of twelve words learned at a time give the most satisfactory results. The explanation is one of the two given above and experiments to justify either one will have to be made before an answer to the problem can be intelligently given.

Another question is: How far will the results of this experiment apply to other material? While it may be safely accepted for other linguistic material, say English-foreign tongue vocabulary, it may prove imprudent to venture to say that it will be best for other material. However, one cannot help thinking of the methods of studying the multiplication table. Nowadays, the method of studying the whole table in a series has been replaced by the more "logical" one of studying combinations separately, for the same reason that studying associated pairs separately was thought to be the best. Whether or not there is any experimental evidence on the subject we do not know, but if there is none, surely it

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may prove worth while to experiment on the question. We cannot say that results obtained with linguistic material should be applied to numbers, we are well aware of the truth stated by Gates [1] that there is a "risk involved in widespread applications of facts found in one field to situations encountered in others." But surely there is enough challenge here to tempt someone to investigate this particular field.

It has seemed interesting to compare these results with those of Warner Brown. His experiment was very similar to this one, except that Brown used nonsense syllables.

His results are, for an immediate recall:

	Whole Method	Part Method
Means	1.92	1.4
	3.89	3.19
	1.64	1.18
	3.34	3.14

If we multiply these results by three, to compare with the present study we have:

	4.76	4.2
	11.67	15.57
	4.92	3.54
	10.32	12.42
Brown (Average)	7.91	8.93
Seibert	12.7	17.84

One must not forget that the Brown lists were read twelve times as against the six repetitions in this study. The class was read to whereas in this investigation the students studied themselves. Also, the material to be remembered was, in one case nonsense syllables and in the other foreign words. The superiority of our results may be due to one of these facts.

Correlations. The correlations between the different methods and the results have been calculated and are as follows:

Correlation between Meth. I and II	= .58
Correlation between Meth. I and III	= .56
Correlation between Meth. I and IV	= .49
Correlation between Meth. II and III	= .64
Correlation between Meth. II and IV	= .36
Correlation between Meth. III and IV	= .23

[1] Gates, A. I.: Psychology for Students of Education, p. 293.

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The correlations are all positive and of about the same value as the correlations that we have found for the other experiments. The correlation between Method III and Method IV however is much lower than the others.

The following correlations were found between the immediate and the relayed recall:

For Meth. I = .83
For Meth. II = .63
For Meth. III = .51
For Meth. IV = .58

The correlations between the immediate and the delayed recalls are rather high, higher in fact than the correlations between the different processes. The correlation for Method I is the highest. One must remember also that it was the method that gave the poorest results in the learning. It will be interesting later to find out whether there is any relation between the amount of original learning and these correlations.

General Conclusion. The results of these experiments justify the findings of Warner Brown, and seem rather conclusive that the whole method of study is superior to the part method not only for connected material but also for associated pairs. But the explanation of the phenomena cannot be given until the experiments indicated above have been made in order to ascertain to what fact this superiority is due.

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CHAPTER VI

On the Optimum Distribution of Relearning—Part I

The purpose of this experiment was to try to find the optimum distribution of relearnings for a list of English-French words over a period of 10 days.

The experiment described in this chapter was a preliminary experiment which was found to be necessary before undertaking the following one. Since important data were gathered in this first experiment, it seems proper to present it together with the second.

For the experiment, a list of twelve English-French words was studied by the students until they could recall the French words twice without mistakes. (The English words were written on the board and the students used these words to check their learning.) The time taken for the learning was recorded in quarters of minutes.

At the end of 50 minutes, there was a written recall of the French words; then those using Method I, began to relearn the words until they could again recall all the words twice without mistake. The time for the relearning was also recorded. For Methods II and III, there was a recall—but no relearning.

Two days after, there was a recall for the three methods. Then in Methods I and II, the material was relearned until the words could be recalled twice without mistakes. In Method III, there was no relearning.

At the end of 10 days, there was a recall followed by a relearning for the three methods.

It was thought, of course, that Method III, in which there had been no relearnings at all would require more time for the relearning of the material than Method I, in which there had been two relearnings and Method II, in which there had

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been one. One could then appreciate the value of each method by the amount of time saved in relearnings. That the time-saving method of measuring the efficiency of a method is unreliable was quite well known, but we needed the measurements in order to devise the second experiment in which the time for relearning would be uniform. In other words this experiment would give us an approximation of the time necessary for the relearning of the material at different intervals and therefore serve as a guide for the allotment of time on the different relearnings. However, the record of accuracy was taken as well as that of time, and this proved very useful later on in checking one experiment by the other.

A final recall was given at the end of 40 days. This was to be the crucial recall whose results would prove the superiority of one method over the other.

In the method that was adopted, an equal amount of learning was provided at the start. We were merely concerned with the distribution of relearnings. A certain material was to be learned for the purpose of determining how long a student can safely do without any reviewing. Should a word once introduced in a lesson be used in the next, or would it be better to wait a week or two before using it again? Will a relearning at the end of the study period be as effective as a relearning 2 days later or even 10 days later?

A certain number of experiments have been made in this field, but practically all have had to do with the original learning of the material, i. e., a certain number of presentations of the material to be learned are made either in bloc or distributed over certain intervals. Of course " relearnings " may also be called learning in the end, but it is believed that the fact that the material was mastered once perfectly may make a difference. However, the experiments will be related enough to each other to enable us to make interesting comparisons.

E. S. Robinson, for instance, had a list of ten three-place numbers learned by three processes. The first process was to study by twelve repetitions at a time, the second process was to study by six repetitions at a time and in the third by three

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repetitions at a time.[1] The distributed study was found to be superior.

Gordon[2] found that spaced reading was more advantageous than concentrated reading for delayed recall. The material used was a piece in prose.

Perkins[3] had syllables studied by sixteen repetitions, one, two, three, four, or eight at a sitting with 1, 2, 3, or 4 days interval between sittings. He too, found that a smaller number of repetitions over more sittings gives a better result. Jost[4] found that two repetitions a day give better results than the same number of repetitions equally distributed over 3, 6, or 12 days.

It is, of course, quite natural to assume that what is true for original learning, may be true for relearnings. However, the material for all these experiments was different from the material of this study and it was thought that the experiment could be repeated with profit in using foreign vocabulary as material.

Loh Leng Tsai,[5] made an experiment very similar to this one, although the material used was English words—nonsense syllables in pairs. In this experiment there is an original learning, then subsequent relearnings differently spaced.

A. has a relearning every...2..3..4.....7.....11 days
B. has a relearning every.....5.....8..9..10..11 days
C. has a relearning every.....3.....5.....7.....9.....11 days

He found that method A gave the best results, for the recalls were thus.

After 14 Days	After 18 Days
A. recalled 61% of the material.	A. recalled 45.5% of the material.
B. recalled 52.3% of the material.	B. recalled 41.0% of the material.
C. recalled 47.6% of the material.	C. recalled 35.5% of the material.

[1] Robinson, E. S.: The Relative Efficiency of Distributed and Concentrated Study in Memorizing. Jour. Exp. Psy., Vol. 4, 1921, pp. 327-343.

[2] Gordon, Kate: Class Results with Spaced and Unspaced Memorizing. Jour. Exp. Psy., 1925, Vol. 8, pp. 337-343.

[3] Perkins, Nellie L.: The Value of Distributed Repetitions in Rote Learning. Brit. Jour. of Psy., 1914, Vol. 7, pp. 253-61.

[4] Jost: Die Associations Festigheit un ihrer Abhangigheit von der Vestechung der Widderholungen. Zeits. f. Psy., 1897, Vol. 14, p. 437.

[5] Tsai, Loh Leng: Relations of Retention to the Distribution of Learning. Jour. of Exp. Psy., Vol. 10, 1925, pp. 30-39.

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The results obtained show that the method in which relearnings occur with an initial frequency followed by a gradual increase in the length of the intervals between relearnings gives the best results.

Our experiment varied slightly from the one just mentioned, in this respect: There was first a complete learning of the material with no time limit. Then each relearning was not limited to a certain number of repetitions, but went on until the material had been relearned completely. The idea was this: leaving the students to themselves, how much time would it take them to relearn the material perfectly, after a certain interval? And assuming that the material had been relearned perfectly what, if any, difference would there be due to the fact that the material had been relearned one, two or three times before the final recall?

A group of sixty-two students participated in this experiment. They were divided into three groups of about the same number, and the lists and methods were rotated in this fashion:

Group I	Group II	Group III
Meth. I....List A	Meth. II...List C	Meth. III..List B
Meth. III..List C	Meth. I....List B	Meth. II...List A
Meth. II...List B	Meth. III..List A	Meth. I....List C

Printed lists of twelve English-French words were distributed to the students together with slips of paper for recording the time and writing the words recalled.

They were told to study the words aloud until they knew the material well enough to repeat the French words twice without mistakes (the English words were written on the board to check the learning). When the students were through, they recorded the time taken for the study on the slip of paper where later on they were to write the recall. The time was recorded at the board every 15 seconds.

At the end of the class period (50 minutes) the English words were written on the board in a different order and a written recall was asked for. As soon as this was completed, the group studying by Method I began a relearning and relearned until they could repeat the list of words twice with-

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out mistakes. The time for the relearning was then recorded on the same slip of paper as the recall. Method II and Method III had a recall but no relearning.

After an interval of 2 days, there was a written recall for all three methods followed by a relearning for Method I and Method II only.

After an interval of 10 days, there was a recall for the three methods, followed by a relearning for all the methods.

A final recall was then asked for at the end of 40 days.

The scoring was done in the usual manner.

Table XXI gives the results for the accuracy recalls after an interval of 50 minutes.

TABLE XXI

AMOUNT RETAINED AFTER AN INTERVAL OF 50 MINUTES

	Meth. I	Meth. II	Meth. III
Total	1869	1879	1757
Average	30.01	30.30	28.33
S. D.	6.36	5.90	6.60
$\frac{(S.\ D.)}{\sqrt{n}}$	.80	.74	.83

An interesting fact and also a rather important one is to be noted here. The results obtained are those of three similar performances; that is, the same material has been learned by the same group and by the same process. Yet, we find that in Method III there is a difference of average of almost 2 points, while the results are very close for Methods I and II. Any attempt to explain this will fail, for in the following experiment, the same thing happens, fortunately not for the same method. The safest explanation appears to be that for rote memory there is, for the same individual or group, a certain variation in the performance of the same intellectual function at different times.

As will be seen later, this rather unfortunate start vitiated the results to such an extent, that it was only in corroborating the results of two consecutive experiments that any conclusions could be drawn. This will show how careful one must

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be in deriving any conclusions and how there can never be too many experiments to corroborate each other.

Table XXII gives the results for the accuracy after an interval of 2 days (in Method I there has been one relearning).

TABLE XXII

AMOUNT RETAINED AFTER AN INTERVAL OF 2 DAYS

	Meth. I (1 relearning)	Meth. II (No relearning)	Meth. III (No relearning)
Total	1780	1705	1544
Average	28.70	27.50	24.90
S. D.	6.84	7.0	8.14
$\frac{\text{(S. D.)}}{\sqrt{n}}$	.86	.88	1.03

The average in Method I is higher on account of the relearning. It is difficult to compare the average for Method II and Method III, since Method II started with an average superior to that of Method III, but, if we calculate the loss from the results of the first recall, Method II has lost a total of 174 points while Method III has lost a total of 213 points. It will be generally observed throughout these experiments that the less a material is learned, the greater is the proportional loss in the recall.

Table XXIII gives the results for the accuracy recalls after an interval of 10 days. In Method I, there have been two relearnings, in Method II, one, and none in Method III.

TABLE XXIII

AMOUNT RETAINED AFTER AN INTERVAL OF 10 DAYS

	Meth. I (2 relearnings)	Meth. II (1 relearning)	Meth. III (No relearning)
Total	1791	1762	1371
Average	28.88	28.42	22.11
S. D.	6.32	6.80	9.34
$\frac{\text{(S. D.)}}{\sqrt{n}}$	.80	.86	1.18

Method I with two relearnings has almost as good an average after 10 days as it had after 2 days. The total score was 1780 and it is now 1791. In other experiments where re-

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learning is allowed in about the same fashion, it is a common occurrence to have the results at the end of 10 days almost as good as the results at the end of 2 days.

Method II with one relearning comes almost but not quite within the results of Method I, showing that one relearning at the end of 2 days is almost as effective as two relearnings one after 50 minutes and the other after 2 days. But the loss of Method III where no relearning has taken place is relatively considerable. The results come within a few units of the results of Method I after a period of 40 days.

Table XXIV gives the results for the accuracy recalls after an interval of 40 days. At that time, there have been relearnings for every method, but while in Method I, there have been three relearnings, in Method II, there have been two, and in Method III, only one. It is well to remember, however, that in each relearning the material was relearned completely.

TABLE XXIV

AMOUNT RETAINED AFTER AN INTERVAL OF 40 DAYS

	Meth. I (3 relearnings)	Meth. II (2 relearnings)	Meth. III (1 relearning)
Total	1337	1228	991
Average	21.56	19.80	15.98
S. D.	7.42	8.66	8.04
$\frac{\text{(S. D.)}}{\sqrt{n}}$	.94	1.09	1.02

While the results of Method II were almost as good as the results of Method I at the end of 10 days, there is a noticeable difference in the results at the end of 40 days. This tends to show that successive relearnings, although they may not show any marked superiority for a recall after a short interval, do at the end of a longer period give better results.

As for the third method, although the relearning at the end of 10 days was sufficient to master the material again as completely as possible, it did not insure as permanent a retention as successive relearnings did.

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The results for the three methods over a period of 40 days have been tabulated in Table XXV, in terms of percentages of the perfect score.

TABLE XXV

AMOUNT RETAINED IN TERMS OF PERCENTAGES OF THE PERFECT SCORE

	Meth. I (3 relearnings) Per cent	Meth. II (2 relearnings) Per cent	Meth. III (1 relearning) Per cent
1st recall	83.73	84.18	78.71
2d recall	*79.74	76.38	69.17
3d recall	*80.23	*78.94	61.42
4th recall	*59.90	*55.01	*44.30

*A relearning has taken place.

The first two methods offer an interesting bit of comparison since the amount retained after the first recall was about the same. Method I is evidently superior to Method II, that is, three relearnings are superior to two. When one makes that statement one must bear in mind that these relearnings are not the same in importance. Since in every case the material had to be relearned completely, each relearning in Method II took more time or at least was expected to take more time than each relearning in Method I. As for Method III, it gave inferior results at the start and this made the comparisons all the more difficult. In order to obviate this in some respects, we have tabulated the loss in terms of percentage of *the amount retained at the first recall.*

The results are given in Table XXVI.

TABLE XXVI

LOSS IN PERCENTAGES OF THE AMOUNT RETAINED AT THE FIRST RECALL

	Meth. I (3 relearnings)	Meth. II (2 relearnings)	Meth. III (1 relearning)
Amount retained (1st recall)	1869	1879	1757
Loss in 2 days	*4.7%	9.2%	12.1%
Loss in 10 days	*4.1%	*6.2%	21.9%
Loss in 40 days	*28.4%	*34.6%	*43.5%

*A relearning has taken place between the recalls.

It seems that this table offers a means of comparison between the three methods, which would not be possible otherwise. There is evidently a greater loss in Method II, than in

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Method I, and in Method III, than in any of the others. We see that two recalls will nearly make up for the loss over an interval of 10 days, and that one relearning although complete will not give as good results as two relearnings. It is also interesting to note that in Method III the loss after two days in 12.1% of the amount retained after 50 minutes, while in Method II (exactly similar to Method III up to that time) the loss is only 9.2%. This seems to justify the contention that the material which has been better learned will be retained much better in proportion than some material not so well learned.

Conclusions. As far as the results for accuracy are concerned, it seems that the method which provides for three relearnings in a period of 10 days gives better results than the methods which provide for only two or only one relearning, *although the material will be relearned completely in every case.*

The better learned material will be better retained proportionally than the poorer learned material. That is, the loss in percentage of the amount retained varies inversely with the amount retained.

The performance of the same group learning the same material in the same way may vary considerably from one day to another. Results obtained on experiments in rote memory must be scrutinized carefully, before one reaches any conclusions. Differences obtained may be the results of pure chance due to the extreme variability in the performance.

Time Tabulations. It is evident that in this experiment, the time element for relearnings was of great significance. It was assumed quite naturally that the unique relearning of Method III at the end of 10 days would take considerably more time than the relearning of Method I or of Method II in which there had been already some relearnings, since in every case the material was to be relearned completely. Indeed, it was expected that the total time for the relearnings would be about the same.

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Tabulating the results in terms of time units (15 seconds) the following table was obtained:

TABLE XXVII

TIME SCORES FOR THE ORIGINAL LEARNING AND RELEARNINGS

	Meth. I		Meth. II		Meth. III	
	Total	Aver.	Total	Aver.	Total	Aver.
1st learning	1543	24.88	1530	24.67	1542	24.83
2d learning	335	5.40	...	...	...	...
3d learning	259	4.1	332	5.35	...	...
4th learning	261	4.2	280	4.5	465	7.5
Total time for relearning	955	13.7	612	9.85	365	7.5

An interesting thing, in view of the results obtained for accuracy, is that the time for the original learning is practically the same. The inferiority of the results of Method III cannot therefore be ascribed to more or less time taken for the learning of the material, but must be explained by the variability of performance for the same task by the same group.

In Method I, the first relearning takes more time than the second, and the second takes about the same time as the third. This corresponds with what we know of the curve of forgetting, i. e., the first big drop occurs almost immediately, and after that the loss is more gradual and rather slow.

In Method II, the first relearning occurred 2 days after, and it did not take any more time to relearn the material perfectly, than it had taken in Method I to relearn the material after an interval of 50 minutes. The same thing happened after 10 days. The time taken for the relearnings do not seem to bear any relation with the interval of time between relearnings. If we remember that in every case a complete mastery of the material was asked for, the short time taken by Method III to relearn the material perfectly after an interval of 10 days is rather puzzling. The time factor complicated the interpretation of the results to such an extent that we cannot find a better illustration of the dangers of experimenting without a uniform amount of time, or of ascertaining the efficiency of a method of learning by the "saving time" method. If one were to judge the efficiency of the

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method by the saving time method, Method III would appear most favorable. On the other hand, if one tried to draw conclusions from the accuracy results alone, he would surely be wrong, for Method III owes its inferiority to the fact that it started with a marked inferiority in the original learning and that the time devoted to relearnings was so much shorter than for the two other methods (465 units of time against 955 for the first method and 612 for the second).

To what was due this difference in the time spent on relearnings?

There is no reason to believe that the students in Method III did not relearn the material as completely as they were told to do. In fact there are excellent reasons to believe that they did so. The explanation lies in the fact that in Method I to a great extent, and in Method II to a marked extent also, there has been an overlearning of the material.

Let us take for example the case of the student making a perfect recall every time. She did not need any relearning, but for the sake of uniformity in the experiment, she had to repeat the list of words twice, to be sure that she could do so. The minimum time to do this was about 30 seconds or two units of time. Then assuming that the student did make a perfect score every time in the three methods, in Method I she repeated nevertheless the material twice at every relearning or six times. In Method II she repeated the material four times, while in Method III which provided only one relearning she repeated it only twice. For all perfect scores, then, there was an overlearning at each relearning, and three times as much for Method I as for Method III. The same reasoning holds true for every word that was known from the first and did not need any relearning. This would account for the difference in the total time taken by the different relearnings. This would certainly be felt in some measure in the results obtained for accuracy.

No conclusions therefore can be safely drawn from this experiment, but it was necessary to make this preliminary study, in order to furnish the data for the next experiment.

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CHAPTER VII

On the Optimum Distribution of Relearning—Part II

A second experiment having the same purpose of determining the optimum distribution of relearnings was undertaken, in which important data and necessary alterations obtained from the previous experiment were used.

It was decided that the time of learning and of relearnings should be uniform, the only difference being in the time distribution of the relearnings.

Taking the results of the preliminary experiment where the students were allowed to study during a time sufficient for the complete mastery of the material, we found that the average time for learning was about twenty-four units or 6 minutes. We then allowed 6 minutes for the original learning. As the study was to be made by a certain number of readings, and each reading took 30 seconds, we then fixed the original learning at twelve readings.

In Method I, the students in relearning the material perfectly, took an average of 5.4, 4.1, and 4.2 units of time for the relearnings, or approximately 1½ minutes for the first relearning and 1 minute for the other two. This gave three, two and two repetitions or a total of seven repetitions.

We had of course to have also seven repetitions for the relearnings by the other methods. Noticing that in Method II, the average was 5.35 and 4.5 units of time, we took four repetitions for the first relearning and three for the second. In the last method there were of course seven repetitions for the relearning.

Forty-seven students participated in this experiment. These students belonged to the group of sixty-two students who had taken part in the previous experiment.

The lists, groups, and methods were rotated in this way:

Group I	Group II	Group III
Meth. I.....List A	Meth. II....List B	Meth. III...List C
Meth. II....List C	Meth. III...List A	Meth. I.....List B
Meth. III...List B	Meth. I.....List C	Meth. II....List A

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Printed lists of twelve English-French words were given to each student. They were read aloud in a rhythmic fashion and at an even speed (30 seconds for one reading of the list). The students were told to read with the intent to remember the French words and they were told in what way the recall would be required.

At the end of the class period (50 minutes) the English words were written on the board and the students wrote as many French words as they could remember. The lists were then collected, and the group studying by Method I relearned the list three times. The two other groups had no relearnings.

Two days after, a recall was asked for from the three groups. Then the group using Method I, relearned the list by reading it twice; those using Method II read the list four times, while those using Method III had no relearning.

At the end of 10 days, a recall was asked for every group. The group using Method I read the list twice; the group using Method II read the list three times; and those using Method III read the list seven times.

Thus when a final recall was asked at the end of 40 days, each method had had the same amount of relearning (seven readings) although differently distributed.

The scoring was done in the usual way, and the results tabulated. Table XXVIII gives the results for accuracy after an interval of 50 minutes.

TABLE XXVIII

AMOUNT RETAINED AFTER AN INTERVAL OF 50 MINUTES

	Meth. I	Meth. II	Meth. III
Total	1423	1312	1337
Average	30.27	27.91	28.44
S. D.	6.42	7.23	6.12
$\frac{(S.\ D.)}{\sqrt{n}}$	.93	1.05	.89

The similarity of these results with those of the first experiment are rather striking. The averages are all between twenty-eight and thirty. Again we have two groups which are very close and one whose results are somewhat different.

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Fortunately while in the first experiment Methods I and II gave similar results for the immediate recall, this time it is Methods II and III which are similar. By analyzing the combined results, we can make up for the difference in the original learning.

Table XXIX gives the results for the recall after an interval of 2 days. In Method I there has been one relearning.

TABLE XXIX

AMOUNT RETAINED AFTER AN INTERVAL OF 2 DAYS

	Meth. I (1 relearning)	Meth. II (No relearning)	Meth. III (No relearning)
Total	1303	1172	1101
Average	*27.72	24.93	23.42
S. D.	6.84	8.4	7.26
$\frac{(S.\ D.)}{\sqrt{n}}$	1.00	1.22	1.06

* A relearning has taken place between the recalls.

Although no relearning has taken place either for Method II or for Method III, the loss for the third method is greater; almost twice as much as for Method II.

Table XXX shows the results after an interval of 10 days. In Method I there have been two relearnings (five readings), and in Method II only one relearning (four readings).

TABLE XXX

AMOUNT RETAINED AFTER AN INTERVAL OF 10 DAYS

	Meth. I (2 relearnings)	Meth. II (1 relearning)	Meth. III (No relearning)
Total	1278	1223	955
Average	*27.19	*26.02	20.31
S. D.	6.96	8.37	8.88
$\frac{(S.\ D.)}{\sqrt{n}}$	1.01	1.22	1.28

* A relearning has taken place between the recalls.

Method I has had one more repetition than Method II. Its average is also slightly superior to that of Method II. But considering that Method II had a lower average than Method I, it will be seen that the loss from Method II is less than from Method I. As for Method III, the average has dropped considerably.

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Table XXXI shows the results after an interval of 40 days. In each method there has been the same amount of relearnings (seven repetitions).

TABLE XXXI

AMOUNT RETAINED AFTER AN INTERVAL OF 40 DAYS

	Meth. I (3 relearnings)	Meth. II (2 relearnings)	Meth. III (1 relearning)
Total	964	938	694
Average	20.51	19.95	14.76
S. D.	8.85	8.49	8.85
$\frac{\text{(S. D.)}}{\sqrt{n}}$	1.29	1.23	1.28

The average for the second method comes very near the average for the first method, and when it will be remembered that the average for the immediate recall was in favor of Method I, it is probable that the second method may be said to give better results. As for the third method, it is decidedly inferior, its average being only 14.76 as against 20.51 for the first method and 19.95 for the second.

Table XXXII gives the accuracy results in terms of percentages of the perfect score.

TABLE XXXII

AMOUNT RETAINED IN PENCENTAGES OF PERFECT SCORE

	Meth. I (3 relearnings) Per cent	Meth. II (2 relearnings) Per cent	Meth. III (1 relearning) Per cent
1st recall	84.10	77.54	79.01
2d recall	77.00	69.26	65.05
3d recall	75.94	72.28	56.44
4th recall	57.01	55.43	41.01

These results show clearly that the third method is inferior to the other two. Evidently a relearning at the end of 10 days is too late even when there is as great a number of repetitions at that one sitting as there has been for the distributed relearnings. As for the two first methods, the superiority of one over the other cannot really be ascertained before determining the loss over a period of 40 days.

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To neutralize as much as possible the difference in the original score, the loss has been calculated in percentage of the amount retained after 50 minutes. The results are given in Table XXXIII.

TABLE XXXIII

LOSS IN PERCENTAGES OF THE AMOUNT RETAINED AFTER 50 MINUTES

	Meth. I	Meth. II	Meth. III
Amount retained (1st recall)	1423	1312	1337
Loss after 2 days	8.15%	9.83%	16.58%
Loss after 10 days	10.18%	6.25%	26.84%
Loss after 40 days	32.25%	26.28%	52.21%

These results tend to show that the second method is probably the best and that a relearning after 50 minutes makes hardly any difference at all. In fact, in the first method with five repetitions the loss is 10.18% of the amount retained originally while with only four repetitions in the second method the loss is only 6.25% of the amount originally retained.

We may now compare these results with the results of the first experiment. Table XXXIV will give the tabulation for both experiments.

TABLE XXXIV

LOSS IN PERCENTAGES OF THE AMOUNT RETAINED AFTER 50 MINUTES FOR BOTH EXPERIMENTS

	Meth. I (3 relearnings)		Meth. II (2 relearnings)		Meth. III (1 relearning)	
	1st ex.	2d ex.	1st ex.	2d ex.	1st ex.	2d ex.
Amt. retained (1st recall)	1869	1423	1879	1312	1757	1337
Loss after 2 days	4.7%	8.15%	9.2%	9.83%	12.1%	16.58%
Loss after 10 days	4.1%	10.18%	6.2%	6.25%	21.9%	26.84%
Loss after 40 days	28.4%	32.25%	34.6%	26.28%	43.5%	52.21%

The third method gives in both cases the poorest results. This cannot be attributed to the amount originally retained since in the second experiment the amount retained was as good as, if not better, than that in Method II. The loss over

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a period of 2, 10 and 40 days can also be compared in the two experiments. They are very similar.

The results are interesting for the two first methods. In the first experiment Method I was slightly superior. In the second experiment Method II is better. However, the variations are slight and are such as may be expected in these experiments.

A comparison of the losses in terms of the perfect score instead of in terms of the amount retained gives the following table.

TABLE XXXV

LOSS IN PERCENTAGES OF THE PERFECT SCORE

	Meth. I		Meth. II		Meth. III	
	1st ex. Per cent	2d ex. Per cent	1st ex. Per cent	2d ex. Per cent	1st ex. Per cent	2d ex. Per cent
Loss after 50 mins.	16.21	15.9	15.82	22.46	21.29	20.99
Loss after 2 days	20.26	23.0	23.62	30.74	30.83	34.95
Loss after 10 days	19.77	24.16	21.06	27.72	38.58	43.56
Loss after 40 days	40.10	42.99	44.99	44.57	55.61	58.99

There is an interesting consistency in the results especially as far as those of the final recall are concerned. It is still open to question whether Method I is really superior to Method II or not, but we think there is no doubt as to the inferiority of Method III.

After combining the results of the two experiments we can infer the following general conclusions:

Conclusions.

1. After a material has been learned, it is desirable to have relearnings not too long after the original learning.

2. One relearning after 2 days seems as effective as the same amount of relearning distributed in two sittings (one 50 minutes and the other two days after the original learning).

3. Seven repetitions after 10 days are not as effective as the same number of repetitions distributed over two or three sittings.

4. The number of repetitions necessary for relearning the material decrease with each subsequent relearning.

5. The variations in the performance of the same function by the same group are such that results must be carefully analyzed before reaching any warranted conclusions.

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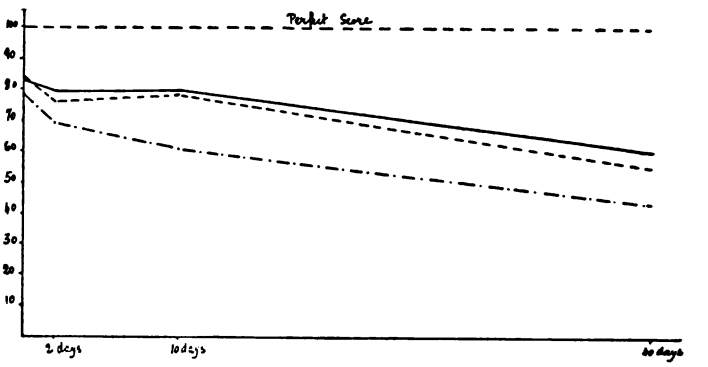
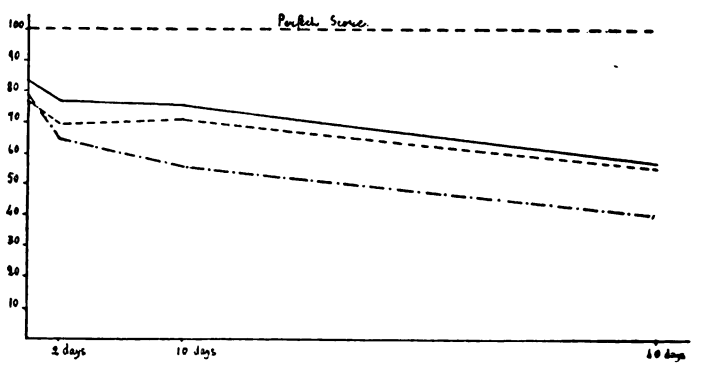
Figs. 4 and 5 show the forgetting curve in terms of percentages of the perfect score for the first and second experiments.



——— Meth. I (3 learnings). - - - - Meth. II (2 relearnings).
—·—·— Meth. III (1 relearning).

FIG. 4—Curve of Forgetting in Terms of Percentages of Perfect Score for a Period of 40 Days. (First Experiment.)



——— Meth. I (3 relearnings). - - - - Meth. II (2 relearnings).
—·—·— Meth. III (1 relearning).

FIG. 5—Curve of Forgetting in Terms of Percentages of Perfect Score for a Period of 40 Days. (Second Experiment.)

A comparison between these curves illustrates clearly the consistency of the results of both experiments. The difference in the immediate drop is due of course to whether there has or has not been a relearning. But the curve for Method III is manifestly inferior.

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Correlations. The correlations between the performance in this experiment are very interesting because they happen to be correlations between the same performance on the same material and by the same group.

Correlations between the first performance and the second = .72
Correlations between the first performance and the third = .62
Correlations between the second performance and the third = .69

These are not very high correlations when the similarity of the performance is taken into account. This explains of course, that the correlations obtained between the performances by different methods could not be much higher than those obtained. It would be interesting to find out whether this is characteristic of rote memory.

General Conclusions. The findings of these experiments together with those of similar experiments tend to show that relearning of material learned by heart ought to take place within, let us say, a period of 2 days after the first learning; that it is advisable to have the same material revised a little later, but that too late a relearning is fatal to the memory of the material. Subsequent relearnings may be less frequent or less important. In the making of text books, it is therefore advisable that new words introduced in one lesson reappear in the next lesson, rather than after an interval of four or five lessons, and be used casually afterwards, since the forgetting is very gradual after the tenth day.

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CHAPTER VIII

On the Relative Efficiency of the Reading *vs.* the Recitation Method of Study

The purpose of this experiment was to ascertain the value of recitation as a factor in memorizing foreign vocabulary. Is recitation of as much value in learning as reading or is a mixed method of reading and recitation a better method of study?

Alexander Kuhn (1914) experimenting on a few adult subjects (six to nine) with syllables, words of one syllable, and short verses, found that recitation was more effective than reading only, for learning and relearning, but did not show whether the material learned was better retained. The last recall occurred after an interval of 96 hours. The learning was stopped when the student "was confident of the mastery of the material" but no time limit was set.[1] Katzaroff experimenting with non-sense syllables found that recitation is superior to reading but in this experiment one reading was matched against one recitation; as recitation takes a longer time than reading the time of study was not uniform.[2] Thorndike repeated the experiment with twenty-eight adults, who memorized four vocabularies of twenty words each. *No time limit was set,* the student stopping when he thought he had mastered the material. In the immediate and only recall it was found that there is no marked superiority of one method over the other.[3] Gates repeated the experiment, with great care and thoroughness. The experiment was on school children up to the eighth grade. The methods differed from each other in the different proportions of reading to recitation. There were two recalls, one immediate and the other three

[1] Kuhn, Alexander: Über Einpragung durch Lesen und durch Reziteirn. Zeitschrift fur Psy., 1914, 68, pp. 396-481.
[2] Katzaroff, Dimitre: Rôle de la Récitation comme Facteur de la Mémorisation. Arch. de Psy., Vol. VII, pp. 225-255.
[3] Thorndike, E. L.: Repetition *vs.* Recall in Memorizing Vocabularies. Jour. of Ed. Psy., 1914, Vol. 5, 596-97.

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or four hours later. The general conclusion of Gates is that the recitation method is superior to the reading method and that the optimum amount of recitation for non-sense material is 80% against 20% of reading. For this optimum amount, he found that the superiority on the reading method was in a ratio of two to one. For meaningful material, the best results are obtained with 40% reading followed by recitation. The results are 27% better than the results obtained by reading.[4]

The difference is accentuated in the delayed recall.

The Gates experiment was done with school children and with non-sense syllables or prose. We thought it would be interesting to repeat it with foreign vocabulary and on college students. Unfortunately, the experiment could not be repeated with the thoroughness of Gates as to the optimum amount of recitation desirable. Therefore a compromise was made in this way. In one method, the material was read by the students for 6 minutes. In another, after one reading, the students studied by the prompting method for 5½ minutes. (The reading took 30 seconds.) They put a card over the French words and tried to recall them at the sight of the English associates. When they failed to recall it they read it and passed to the next one repeating the same process of learning. In a third method the students read the list for a period of three minutes and then began to recall by the prompting method during the other 3 minutes.

Sixty college students participated in this experiment. They were divided in three groups of about the same number and they all had had about the same training in French (second year college French).

The material used was made of lists of twelve English-French words, prepared in the way referred to in Chapter I. In the recalls the English words were given in different order and the French word was to be recalled.

There were four recalls: the first one after 50 minutes, and the others after an interval of 2, 10, and 40 days re-

[4] Gates, A. I.: Recitation as a Factor in Memorizing. Arch. of Psy., 1917, N. 40, 37-40.

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spectively. There was a relearning after the second and the third recall. The first relearning (2 days after the original learning) took 3 minutes and the second relearning (10 days after) took 2 minutes. They were done by the method similar to the original learning.

The methods, lists, and groups were rotated in the following way:

Group I	Group II	Group III
Meth. I.....List A	Meth. II....List C	Meth. III...List B
Meth. II....List B	Meth. III...List A	Meth. I.....List C
Meth. III...List C	Meth. I.....List B	Meth. II....List A

Precise and complete indications were given the students as to the manner in which the material had to be studied. In the reading method, they were told to read the material with the intent to memorize, but not to attempt any recitation whatever. In the recitation method, they were told not to read any word before an honest attempt at recalling it had been made. The students were also told what would be expected in the recall and the way it would be asked for; i. e., that the English words would be given, and the French word was to be recalled.

The time of learning and relearning had been derived from previous experiments so as to insure a proper mastery of the material.

The results of the experiments have been tabulated in terms of amount retained only, since the time of study was uniform.

The scoring was done in the usual way.

Table XXXVI shows the amount retained after an interval of 50 minutes. Method I, is the reading method, Method II, is the mixed method (half reading and half recitation), and Method III, is the recitation method.

TABLE XXXVI

Amount Retained After an Interval of 50 Minutes

	Meth. I Read.	Meth. II ½ Read.	Meth. III Recit.
Total	1457	1591	1679
Average	24.28	26.61	27.98
S. D.	8.34	8.04	6.42
$\frac{(S.D.)}{\sqrt{n}}$	1.07	1.04	.82

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The immediate recall shows a distinct superiority of the recitation method over the reading method, while the mixed method gives results intermediary between the other two. The distributions however, are rather widely spread, especially the first two making the reliability of the average a little more uncertain. There is however, a rather marked difference in the averages, being 24.28 for the first method as against 27.98 for the last.

It was noticed during the scoring, that in Method III there were a great number of words given with an imperfect spelling. That is almost what one would expect for there was very little time in which to look at the word and the premature recall would of course be slightly imperfect. The sound of the word would be mostly remembered (the study was made aloud) and no checking of the spelling occurred; therefore, an original mistake would not have any opportunity of being checked and corrected.

Table XXXVII gives the amount retained after an interval of 2 days. No relearning has taken place, between the first and second recall.

TABLE XXXVII

AMOUNT RETAINED AFTER AN INTERVAL OF 2 DAYS

	Meth. I Read.	Meth. II ½ Read.	Meth. III Recit.
Total	1330	1397	1679
Average	22.16	23.28	24.35
S. D.	8.19	9.06	7.89
$\frac{(S.D.)}{\sqrt{n}}$	1.05	1.17	1.02

The marked difference between the three methods that we observed in the first recall has somewhat diminished after an interval of 2 days, although the relative place of each method remains the same. Method I is still inferior, Method II still gives intermediary results, and Method III is still superior. However, the spread of the distributions and the

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value of $\frac{S.D.}{\sqrt{n}}$ shows that there may be a possibility of overlapping among the three methods.

The most striking thing about these distributions is their wide spread, especially for Method II. The S. D. obtained were probably the highest obtained in this series of experiments and they remind one of the distributions obtained in the final recalls. There is no doubt that the observation of Gates in regard to the considerable amount of individual differences he noticed in his experiment is true here also.

Table XXXVIII gives the results after an interval of 10 days. A relearning of 3 minutes has taken place between the two recalls.

TABLE XXXVIII

AMOUNT RETAINED AFTER AN INTERVAL OF 10 DAYS

	Meth. I Read.	Meth. II ½ Read.	Meth. III Recit.
Total	1540	1605	1631
Average	25.6	26.75	27.18
S. D.	7.98	7.98	8.34
$\frac{(S.D.)}{\sqrt{n}}$	1.03	1.03	1.07

The results show the same ranking of the three methods in regard to efficiency, but the difference is very small. A most remarkable fact is that the results are better than those obtained after 50 minutes, except for the third method which is slightly inferior. We have already seen that a relearning generally makes up for the natural loss over an interval of 10 days, but this is the first time the results have been actually superior.

The difference between the results obtained by the three methods grows smaller and smaller. After 50 minutes the difference of average between the best method and the poorest was 3.70. After 2 days it was 2.19, after 10 days it is only 1.58.

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Table XXXIX gives the results obtained after an interval of 40 days. Two relearnings have taken place since the original learning.

TABLE XXXIX

AMOUNT RETAINED AFTER AN INTERVAL OF 40 DAYS

	Meth. I Read.	Meth. II ½ Read.	Meth. III Recit.
Total	1273	1431	1404
Average	21.21	23.85	23.40
S. D.	8.25	7.77	8.40
$\frac{(S.D.)}{\sqrt{n}}$	1.06	1.00	1.08

A very interesting thing has taken place here: the displacement of Method III in favor of Method II. While the difference is hardly noticeable, the trend is most significant, the results of Method II have been steadily improving as compared with the others, and we probably will be nearer the truth when we say that at the end of 40 days, the two methods are about the same as far as results are concerned.

The results have been calculated in terms of percentages of the perfect score, and are given in Table XL.

TABLE XL

AMOUNT RETAINED IN TERMS OF PERCENTAGE OF THE PERFECT SCORE

	Meth. I Read. Per cent	Meth. II ½ Read. Per cent	Meth. III Recit. Per cent
1st recall	67.45	73.65	77.73
*2d recall	61.57	64.67	67.63
*3d recall	71.25	74.30	75.50
4th recall	58.93	66.25	65.00

* A relearning has taken place between the recalls.

The results show that after an interval of 50 minutes, Method III gives results superior to those of the other two methods, and these results are superior to about an amount of 10% of the perfect score, over those of Method I. However, the amount of loss over a period of 40 days is greater for Method III than for any of the other two causing a slight displacement in the method. Method III loses 12.73% of the perfect score in 40 days, Method II loses only 7.40% and Method I, 8.52% of the perfect score. The slow im-

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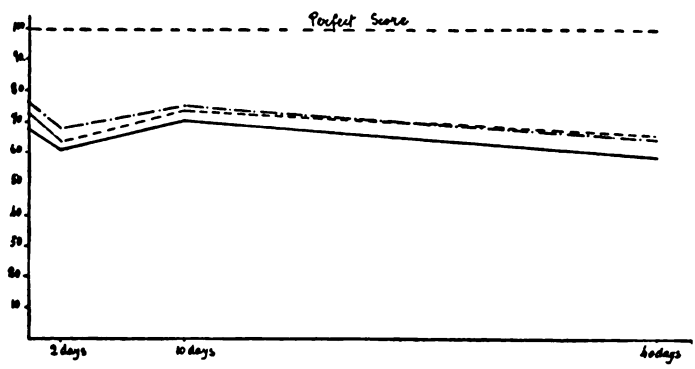
provement of Method II is very clear in the table, and would probably continue to improve over a longer period of time.

However, the loss over a period of 40 days is remarkably small—varying from 7.40% to 12.73% and the amount retained at the end of that period is from 58.93% to 66.25% of the perfect score. It must be remembered, however, that two relearnings took place, the total time for which took 5 minutes as compared with 6 minutes for the original learning.

The total amount of learning was 11 minutes. It is interesting to compare the results with those of the experiment



——— Meth. I (Reading). - - - - Meth. II (Reading Recitation).
—·—·— Meth. III (Recitation).

FIG. 6—Curve of Forgetting in Terms of Percentage of the Perfect Score for a Period of 40 Days.

of Chapter IV, where the total amount of learning was 9 minutes only.

This curve illustrates very clearly what has taken place over a period of 40 days. Method II, inferior up to a period of 10 days, very soon becomes as good if not better than Method III. The trend of the lines shows that it would be superior over a longer period. Observe the unusual gain from 2 to 10 days, and also how in every case but the last, the recall at the end of 40 days gives results similar to those at the end of 2 days. It will be a very interesting curve to compare with others obtained in the series of experiments.

Conclusions. The recitation method seems to give results superior to those of the reading method. This superiority

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varies from 10% of the perfect score for an immediate recall to 6% for a recall at the end of 40 days. We do not find anywhere the enormous superiority of the recitation method that Gates found in his experiment.

A mixed method of half-recitation and half-reading is superior to the reading method. It is inferior to the recitation method for an immediate recall, but is slightly superior after an interval of 40 days.

This shifting in the relative efficiency of the methods over a period of time, already noticed in another experiment, emphasizes the need of experimenting over a certain length of time.

A minimum amount of reading before beginning the recalls accounts for the great number of words given with slight mistakes in spelling.

There are a great number of individual differences both in the original learning and in the recalls. The distributions were more widely spread in this experiment than in any other experiment in these series.

A relearning after 2 days made up for the natural loss over a period of 10 days. This has been true all along.

Correlations. The following correlations were found between the different methods:

Correlation between Meth. I and Meth. II = .71
Correlation between Meth. I and Meth. III = .64
Correlation between Meth. II and Meth. III = .44

The following correlations were found between the immediate and the delayed recalls:

For Method I = .36
For Method II = .56
For Method III = .44

General Conclusions. None of the investigators working on the same problem found the reading method superior to the recitation method. Two of them, Thorndike and Kuhn, found hardly any superiority of one method over the other. Katzaroff found a great superiority for the recitation method, but everything in the experiment was loaded in favor of this method. Gates in a very carefully controlled experiment

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found an enormous superiority of the recitation over the reading method, especially with children. Our experiment, also controlled, does not show this enormous advantage. It would be interesting to investigate whether or not this difference is due to the attitude of the learners. We had college students eager to cooperate in a scientific experiment. They were told that when reading an effort should be made to read with the intention of memorizing. It may be safely assumed that for them reading had its maximum learning value. Can the same be said of children? Reading may become quickly a merely passive exercise while recitation has to be active at all stages of learning. This alone would secure an enormous advantage for the recitation method. We quote here a few opinions on this question of passive reading: Bassett says, "Given a stable passive attitude on the part of the observer, the meaning of a familiar monosyllabic noun repeated aloud three times per second drops away in about 3 to 3½ seconds."[5] Smith states, "Repeated repetitions impress the subject matter on memory, but its effects are surprisingly small."[6] Myers says, "Feeling and general attitude of the subjects towards the task factored highly in the recall performance."[7]

This would corroborate our opinion that with a passive attitude, the learning is slower than with an active attitude of mind. A "reading" therefore, is not of the same value at all times and with all observers, and the younger the child the less will he get from repeated readings. This would tend to explain the great superiority of one method over the other. Already with adults Gates found that more reading is desirable and that the advantage of the recitation method is not as great as with children.

These observations may probably explain the difference between the results obtained in our experiment and those obtained by Gates.

[5] Bassett, M. F., and Warne, C. J.: On the Lapse of Verbal Meaning with Repetition. Am. Jour. Psy., 1919, Vol. 30, pp. 415-418.
[6] Smith, W. G.: The Place of Repetition in Memory. Psy. Rev., 1896, Vol. 3, pp. 21-22.
[7] Myers, G. C., and Myers, C. E.: Reconstructive Recall. Am. Jour. Psy., 1916, Vol. 27, pp. 493-506.

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CHAPTER IX

A Comparison of Our Findings with those Obtained by Other Investigators in the Field of Learning and Retention

ON THE RELATIVE EFFICIENCY OF SEVERAL METHODS OF LEARNING

1. *Studying Aloud vs. Studying Silently.*

(a) The method of studying aloud is superior to the method of studying silently or studying aloud with a written recall.

(b) The method of studying aloud with a written recall gives as good results as the method of studying aloud in the first recall, but becomes the worst of the three methods at the end of 40 days.

These findings are corroborated by the following experimenters:

Munsterberg, "A series of presentations offered to two senses at the same time is much more easily reproduced than if given only to sight or hearing." [1]

Whitehead, "Matter memorized aurally appears to be retained slightly better than that memorized visually." [2]

O'Brien, "The manumotor imagery does not aid either the learning or the recall." [3]

Sybel, "Reading aloud is more favorable for rapidity of learning than silent reading." [4]

[1] Munsterberg, Bigham: Studies from Harvard Psy. Lab. Memory. (Audible and Visual Presentation.) Psy. Rev., 1894, pp. 34-39.

[2] Whitehead, L. G.: A Study of Visual and Aural Memory Processes. Psy. Rev., 1896, Vol. 3, pp. 258-269.

[3] O'Brien, F. G.: A Qualitative Investigation of the Effect of Mode of Presentation Upon the Process of Learning. Am. Jour. Psy., 1921, Vol. 32, pp. 249-283.

[4] Sybel, von A.: Über das Zusammenwirken Verachudener Sinnesgebiete bei Gedachtnisleistungen. Zeits. f. Psy., Vol. 53, 1909.

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2. *Associated Pairs vs. Context.*

(a) The method of learning the vocabularies in a list of associated pairs is superior to the method of learning the words in a verbal context.

(b) The superiority is very marked both for an immediate recall and for a delayed recall (40 days).

(c) The mixed methods (half pairs and half context) while giving intermediate results after an immediate recall, gives results similar to the context method in a delayed recall (40 days).

In the nearest experiment done in this field Shuh Pan, found that, "The recall of any material is favored by the presence of an environmental factor which has some associative connection with the material. In absence of such a connection, environmental situation is likely to be unfavorable to recall."[5]

3. *Whole Method vs. Part Method.*

(a) The part method of studying pair associates (one pair at a time) is inferior to the whole method (the whole list at a time) for the recall of the individual bond between each pair.

(b) Intermediate methods, while giving intermediate results after an interval of 50 minutes, do not maintain their medium place. At the end of 40 days, they give the poorest results.

Experimenters on the Whole *vs.* Part Method of Learning have reached the following conclusions:

Lakenan, "The whole method is more economical than the part method."[6]

Pyle, "Learning by whole is without exception more economical than learning by parts."[7]

[5] Shuh Pan: The Influence of Context Upon Learning and Recall. Jour. Exp. Psy., 1926, Vol. 9, pp. 468-491.

[6] Lakenan, Mary: The Whole and Part Method of Memorizing Poetry and Prose. Jour. Educ. Psy., 1913, Vol. 4, pp. 189-198.

[7] Pyle, W. H., and Snyder, J. C.: The Most Economical Unit for Committing to Memory. Jour. Educ. Psy., 1911, Vol. 2, pp. 133-142.

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Brown, " The whole method gave better results than the part method." [8]

Reed, " 169 college students showed that the part and whole method of procedure had on the average equal value for comprehensive meaning of prose, although the study of the results by individuals shows that most of them find part procedure superior." [9]

4. *Optimum Distribution of Relearnings.*

(a) A given material having been learned perfectly; a certain amount of relearning concentrated on one sitting at the end of 10 days is not as effective for the retention of that material as the same amount of relearning distributed over two or three sittings during the same period of time.

(b) One relearning after 2 days appears to be as effective as two relearnings (one after 50 minutes and the other 2 days after the learning).

(c) The optimum distribution of a certain amount of relearning (seven repetitions) appears to be as follows: four repetitions after an interval of 2 days and three repetitions after an interval of 10 days.

Several experimenters on the optimum distribution of learnings or relearnings reached the following conclusions:

Robinson, " There is a greater superiority of distributed learning after 24 hours than after 5 or 20 minutes." [10]

Tsai, " The results are in favor of distributions with an initial frequency followed by gradual increase in length of time intervals by subsequent relearnings." [11]

Gordon, " Concentrated reading is slightly advantageous in immediate recall, spaced reading is more advantageous in delayed recall." [12]

[8] Brown, Warner: Whole and Part Method in Learning. Jour. Educ. Psy., 1924, Vol. 15, pp. 229-233.

[9] Reed, H. R.: Part and Whole Method of Learning. Jour. Educ. Psy., 1924, Vol. 15, pp. 107-115.

[10] Robinson, E. S.: The Relative Efficiency of Distributed and Concentrated Study in Memorizing. Jour. Expr. Psy., 1921, Vol. 4, pp. 327-345.

[11] Tsai, L. L.: Relations of Retention to the Distribution of Learning. Jour. Expr. Psy., 1927, pp. 30-39.

[12] Gordon, Kate: Class Results with Spaced and Unspaced Memorizing. Arch. Psy. Vol., 1917, Vol. 37-40, No. 40.

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5. *Recitation vs. Reading.*

(a) The recitation method gives superior results to those obtained by the reading method. This superiority varies from 10% of the perfect score for a recall after 50 minutes to 6% for a delayed recall (40 days).

(b) A mixed method (half reading and half recitation) is superior to the reading method. It is inferior to the recitation method (minimum reading) for an immediate recall, but is slightly superior after an interval of 40 days.

Kuhn found that "For all material, the recitation is a more effective method of learning than reading only. There is a greater advantage for senseless and unconnected material. But the material learned by recitation is not better retained than the material memorized by reading alone." [13]

Katzaroff found that recitation is superior to the reading method but he does not use a uniform time.[14]

Thorndike, "No demonstrable superiority of one method over the other was found." [15]

Gates.

1. "The recitation method is superior to the reading method."

2. "For the optimum amount of reading (20% reading for non-sense syllables) the superiority of the results is about two to one."

3. "The advantage of recitation over reading is more pronounced in delayed (four hours) than in immediate recall." [16]

II—ON THE IMPORTANCE OF A DELAYED RECALL

1. We found in our experiments that the efficiency of a method cannot be ascertained with an immediate recall only.

2. In all our experiments we found a shifting in the relative place of the methods over a period of 40 days.

[13] Kuhn, Alexander: Über Einpragung durch Lesen und durch Rezitieren. Zeits. f. Psy., 1914, 68, pp. 396-481.

[14] Katzaroff, Dimitre: Rôle de la Récitation comme Facteur de la Mémorisation. Arch. de Psy., Vol. VII, pp. 225-255.

[15] Thorndike, E. L.: Repetitions *vs.* Recall in Memorizing Vocabularies. Jour. Educ. Psy., 1914, Vol. 15, pp. 122-138.

[16] Gates, A. I.: Recitation as a Factor in Memorizing. Arch. Psy., Vol. 37-40, No. 40, 1917.

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3. This shifting was particularly apparent whenever there was a " mixed " or " intermediary " method.

4. As in all cases but one, the results for these intermediary methods became poorer and poorer; this tends to show that there was a confusion in recall which may be due to the fact that changing from one method to another gave distractions which interfered with the learning process.

The following experimenters seem to agree with us on the importance of a delayed recall:

Lakenan, " Retention does not appear to be adequately tested by a relearning after 24 hours. The results are often reversed for relearnings after several months." [17]

Myers, " The number of correct units recalled after 1 day is greater for an immediate recall." [18]

Myers, " Perhaps the delayed recall offers the richest field for memory study." [19]

Gordon found some reminiscence in 4% of the subjects, and more frequently in poor memorizers." [20]

Brown, " Two tests of memory do not agree because neither recall is a final measure. Each contains items by chance and each omits items by chance." [21]

Gates, " The difference shown by recalls 3 or 4 hours later is twice as great as those shown in an immediate test." [22]

Ballard, " After memorizing imperfectly a piece of poetry a child as a rule can remember more after a few days than immediately after learning." [23]

[17] Lakenan, Mary: The Whole and Part Method of Memorizing Poetry and Prose. Jour. Educ. Psy., Vol 4, 1913, pp. 189-198.
[18] Myers, G. C.: Confusion in Recall. Jour. Educ. Psy., 1917, Vol. 8, pp. 166-175.
[19] Myers, G. C., and Myers, C. E.: Reconstructive Recall. Am. Jour. Psy., 1918, Vol. 29, pp. 316-326.
[20] Gordon, Kate: Class Results with Spaced and Unspaced Memorizing. Jour. Exp. Psy., 1925, Vol. 8, pp. 337-343.
[21] Brown, Warner: To What Extent Is Memory Measured by a Single Recall. Jour. Exp. Psy., 1923, Vol. 6, pp. 376-382.
[22] Gates: Op. cit.
[23] Ballard, P. H.: Obliviscence and Reminiscence. Brit. Jour. Psy. Mon. Sup. 1-3.

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III—ON INDIVIDUAL DIFFERENCES AND VARIABILITY

1. In all our experiments we have noticed great individual differences.

2. These individual differences are more accentuated in the amount retained than in the time taken for the learning or relearning.

3. Individual differences in memory are best ascertained when there has been a reasonable amount of study. These differences tend to disappear when there is either too much or too little learning.

4. There may be large variations in the performance of the same function by the same group with the same material.

5. These variations are such that results must be carefully analysed before any warranted conclusions may be reached.

A great number of investigators found individual differences. Worcester, says, " There are wide differences between individuals both in learning and retention." [34] Myers, " There are great individual differences for both recognition and recall." [35] Henmon, " There are great individual differences." [36] Thorndike, also states, " There are great individual differences." [37] Gates, " Considerable individual differences were found." [38]

IV—RELATION BETWEEN TIME OF LEARNING AND RETENTION

We reached the following conclusions in the light of our investigations:

1. Time is shown to be a poor term of comparison when the efficiency of several methods of learning is to be ascertained.

[34] Worcester, D. A.: Memory by Visual and Auditory Presentations. Jour. Educ. Psy., 1925, Vol. 16, pp. 18-27.
[35] Myers, G. C.: Comparative Study of Recognition and Recall. Psy. Rev., 1914, Vol. 21, pp. 442-456.
[36] Henmon, V. A.: The Relation Between Mode of Presentation and Retention. Psy. Rev., 1912, pp. 79-95.
[37] Thorndike, E. L.: Memory for Paired Associates. Psy. Rev., 1908, Vol. 15, pp. 122-138.
[38] Gates, A. I.: Recitation as a Factor in Memorizing. Arch. Psy., 37-40, No. 40, 1917.

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2. The so-called "saving method" of Ebbinghaus could probably be abandoned with profit and memory better measured in terms of the amount retained.

3. While we found rather large individual differences in the time spent on the original learning, very slight differences were found in the time spent on subsequent relearnings.

4. We found that individuals differ more in retention than in learning ability.

5. The correlations found between time and accuracy are all *negative* and rather small, .23, .25 and .39, which would tend to show that the quick learners are also those that retain most.

In these conclusions we are in accord with a great number of investigators.

Reed, "The saving method is a false measure of retention for it does not express the efficiency of memory." [30]

Henderson, "Those who learn quickest retain in general a greater percentage of what they have learned." [31]

Bennett, "There is no relation between the speed of learners and accuracy of performance." [32]

Guillet, "Easy come, easy go" is proved to be erroneous as a general statement." [33]

Thorndike, "The quick learners are the quick retainers." [34]

Pyle, "The fast learner is more accurate than the slow learner." [35]

Norsworthy, "The rapid learners have the highest percentages of recall." [36]

[30] Reed, H. R.: Associative Aids—Their Relation to Learning, Retention and Other Associations. Psy. Rev., 1918, Vol. 25, pp. 128-55.
[31] Henderson, E. N.: A Study of Memory for Connected Trains of Thought. Psy. Rev. Mon., 1903, Vol. 5, No. 23.
[32] Bennett, Faye: The Correlations Between Different Memories. Jour. Exp. Psy., 1916, Vol. 1, pp. 404-418.
[33] Guillet, Cephas: A Study of the Memory of the Young Women. Jour. Educ. Psy., 1917, Vol. 8, p. 65.
[34] Thorndike, E. L.: Memory for Paired Associated. Psy. Rev., 1908, Vol. 15, pp. 122-138.
[35] Pyle, W. H.: Retention as Related to Repetition. Jour. Educ. Psy., 1911, Vol. 2, pp. 311-321.
[36] Norsworthy, Naomi: Acquisition as Related to Retention. Jour. Educ. Psy., 1912, Vol. 3, pp. 214-218.

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Paterson, "Those who learned the most take the least time." [36]

Worcester, "The one who learns the more rapidly retains the more." [37]

Reed, "Quickly learned, slowly forgotten." [38]

Bigham, "The memory which acts quicker acts better." [39]

Myers, "There is no correlation between time used on recalling and accuracy of recall." [40]

Bean, "The rapidity of learning and rapidity of forgetting is in inverse ratio." [41]

Finkenbinder, "The rapid learners may remember more than the slow learners." [42]

V—ON THE RELATIONS BETWEEN DIFFERENT METHODS OF LEARNING

We have found that the correlations between different methods of learning were all positive and fairly high. This fact tends to show that a good memory remains good whatever the methods of learning may be. This would discredit the belief that there are various types of memories, and that no general rule of learning can be applied to a whole group.

We are giving here a summary of the correlations obtained between various methods of learning through this investigation.

	r(I-II)*	r(I-III)	r(I-IV)	r(II-III)	r(II-IV)	r(III-IV)
1st Exper.†	.67	.56	...	.55	...	...
2d Exper.	.50	.59	.35	.44	.50	.73
3d Exper.	.58	.56	.49	.64	.36	.23
4th Exper.	.72	.62	...	.69	...	...
5th Exper.	.71	.64	...	.44	...	...

* Read: correlation between Meth. I and Meth. II.

† For methods of learning in first experiment, see page 25; in second experiment, page 39; in third experiment, page 53; in fourth experiment, page 73; in fifth experiment, page 81.

[36] Paterson, Harvey: A Class Experiment on Individual Differences in Memory. Jour. Educ. Psy., 1925, Vol. 16, p. 246-250.

[37] Worcester, D. A.: Memory by Visual and Auditory Presentation. Jour. Educ. Psy., 1925, Vol. 16, pp. 18-27.

[38] Reed, H. B.: Associative Aids—Their Relation to Learning, Retention, and Other Associations. Psy. Rev., 1918, Vol. 25, pp. 128-155.

[39] Bigham, John: Influence of Time Interval Between Learning and Recollecting. Psy. Rev., 1894, Vol. 1, pp. 453-461.

[40] Myers, G. C.: A Study in Incidental Memory. Arch. of Psy., n. 22-26, 1913.

[41] Bean, C. H.: The Curve of Forgetting. Arch. Psy., No. 16-21, 1912.

[42] Finkenbinder, E. O.: The Curve of Forgetting. Am. Jour. Psy., 1913, Vol. 24, pp. 8-32.

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The means obtained are .59, .52, .47, .67, and .59.

These correlations show that individuals tend to maintain their rank regardless of the method of learning used. In other words, those who retain best by one method are also those who retain best by another.

Our conclusions are corroborated by the following investigators:

Worcester, "The one who learns easily by one method learns well by others." [45]

Woody, "Those subjects who did well with the oral method did well with the silent method also." [46]

Henmon, "The correlations of abilities with different forms of presentation are positive and very high." [47]

Henderson, "Individuals tend to keep the same rank in power to learn in various tests." [48]

VI—ON THE CORRELATIONS BETWEEN IMMEDIATE AND DELAYED RECALL

We found the following correlations between immediate (after 50 minutes) and delayed recall (after 40 days):

First experiment	Second experiment	Third experiment	Fourth experiment
$r = .44$	$r = .49$	$r = .83$	$r = .36$
$r = .37$	$r = .61$	$r = .63$	$r = .56$
$r = .54$	$r = .50$	$r = .51$	$r = .44$
	$r = .56$	$r = .58$	

The means obtained are .45, .54, .64, and .44 respectively.

These correlations are all positive and fairly high. We must also remember that our "immediate" recall is really a recall after a 50-minute interval and that our delayed recall is after an interval of 40 days. Quite a number of investigators have calculated the correlations between immediate and de-

[45] Worcester, D. A.: Memory by Visual and Auditory Presentation. Jour. Educ. Psy., 1925, Vol. 16, pp. 18-27.

[46] Woody, Clifford: The Effectiveness of Oral *vs.* Silent Reading in the Initial Memorizing of Poems. Jour. Educ. Psy., 1922, Vol. 13, pp. 477-483.

[47] Henmon, V. A.: The Relation Between Mode of Presentation and Retention. Psy. Rev., 1912, Vol. 19, pp. 79-95.

[48] Henderson, E. N.: A Study of Memory for Connected Trains of Thought. Psy. Rev., 1903, Vol. 5, No. 23.

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layed recalls, and although the intervals between the recalls vary with each experiment, it is interesting to compare their findings with ours.

Pyle found "a high correlation between immediate and delayed recall." [47]

Myers found that the correlation between the first and the second recall (from an hour to 2 weeks) was .71.[48]

Norsworthy found that between the first and the second recall (30 days) there is a correlation of .60.[49]

Lee found a value of .47 for the coefficient of correlation between immediate and delayed recall (24 hours).[50]

Jones found that r equal .57 between immediate and delayed recall.[51]

Gordon finds a value of .42 for the coefficient of correlation between the immediate and delayed recall (3 weeks).[52]

Thorndike found the raw correlation between immediate and delayed recall to be .55 (24 hours). He adds, "The correlation between the retention of the effects of an experience for 1 or 2 minutes and their retention for 1 or 2 days seems to be one of the closest yet measured in human nature." [53]

Brown, "The correlation between the amount of the first learning and the amount retained after intervals from 8 to 16 minutes is from .96 to .52.

"What we remember after 3 or 7 days depends more upon what we can remember for 8 or 16 minutes than what we can remember directly after learning." [54]

[47] Pyle, W. H.: Retention as Related to Repetition. Jour. Educ. Psy., 1911, Vol. 2, pp. 311-321.
[48] Myers, G. C.: Recall in Relation to Retention. Jour. Educ. Psy., 1914, Vol. 5, pp. 119-130.
[49] Norsworthy, Naomi: Acquisition as Related to Retention. Jour. Educ. Psy., 1912, Vol. 3, pp. 214-218.
[50] Lee, Ang Larfen: An Experimental Study of Retention and Its Relation to Intelligence. Psy. Rev., Vol. 34, n. 157 (mon.).
[51] Jones, Harold: The Effect of Examination upon Permanence of Learning. Arch. of Psy., 63-68, n. 68.
[52] Gordon, K.: Class Results with Spaced and Unspaced Memorizing. Jour. Exp. Psy., 1925, Vol. 8, pp. 337-343.
[53] Thorndike, E. L.: Op. cit.
[54] Brown, Warner: Effects of Intervals on Recall. Jour. Exp. Psy., 1924, pp. 469-474.

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Gates found a positive and high correlation of .73 and .89 exists between immediate and delayed recall (3 to 4 hours).[86]

VII—ON THE CURVE OF FORGETTING

1. *Amount Retained.* The amount retained either after an immediate recall or after an interval of 40 days is generally very high. It is a fact generally recognised that in the first investigations on memory, the amount of forgetting was unusually high. This fact may have been due to the material used which consisted generally of nonsense syllables learned in series, or it may be that the way to measure the loss (by the saving time method) did give an inaccurate measure of the real amount of forgetting that had taken place. This may also be due to the fact that a good number of these experiments were made on but one subject and the memory of this particular observer may not have been exceptionally good. Whatever the reason may be, modern investigators have found that the tenacity of the connections formed is more lasting than it was generally thought.

We would like to give here the opinion of two investigators as to the fact that nonsense syllables may not give as good results as other material. Guillet says, "Nonsense syllables are less easily acquired than words for immediate reproduction."[87] Bigham finds that "syllables are not remembered as well as words."[88]

In five experiments where the material was learned to the extent of two repetitions or where the time was measured on the amount necessary to secure a perfect mastery of the material, we found the amount retained as follows:

Immediate recall (50 minutes) Per cent of perfect score	Delayed recall (40 days) Per cent
First Exp. from 82 to 75	From 51 to 41
Second Exp. from 93 to 78	From 70 to 58
Fourth Exp. from 78 to 67	From 66 to 59
Fifth Exp. from 84 to 78	From 60 to 44
Sixth Exp. from 84 to 78	From 57 to 41

[86] Gates, A. I.: Correlations of Immediate and Delayed Recal. Jour. Educ. Psy., 1918, pp. 489-496.

[87] Guillet, Cephas: A Study of the Memory of Young Women. Jour. Educ. Psy., 1917, Vol. 8, p. 65.

[88] Bigham, John: Influence of Time Interval between Learnings and Recollecting. Psy. Rev., 1894, Vol. 1, pp. 453-461.

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There is a great consistency in these results although the methods, the groups and the time of learning differ slightly in every one of these experiments. When we consider that this investigation was carried on for 5 years and that a new set of students participated in each experiment, the consistency of the results should give us an added confidence in the value of the investigation.

To test this consistency further, we arranged the results of the experiments according to the original time of learning and obtained the following:

Time of learning	Amount retained after 50 minutes Per cent of perfect score
9 minutes	86
6 minutes	57
3 minutes	42

If the same averages are calculated for the amount retained after an interval of 40 days according to the total time of study (learning and relearnings) we obtained the following results:

Total time of study	Amount retained after 40 days Per cent of perfect score
3 minutes	21
8 minutes	42
9 minutes	60

In considering these results, care must be taken not to make too close a comparison between time and results since every condition for each experiment was different. But we would expect to find a trend in the results somewhat similar to what we found. This by the way illustrates the necessity of having uniform time in testing methods, since there is a constant relation (for each individual) between the time spent on study and the amount retained.

It may be of interest to compare our results with those obtained in other experiments. Of course, the material, time of study and type of experiments vary with each investigation; also the forgetting in some of them is given in amount of time saved in relearning instead of the amount retained. Nevertheless, some interesting points of comparison may be found.

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Finkenbinder gives the following table, in a comparison between his results with those of Ebbinghaus and Radossawljewitch. (The material used was nonsense syllables and the forgetting was calculated in terms of the time taken for the relearning.) [88]

AMOUNT FORGOTTEN AFTER LAPSE OF DIFFERENT INTERVALS OF TIME

After	Finkenbinder nonsense syl. 1 repetition	Radossawljewitch nonsense meaning 2 repetitions		Ebbinghaus nonsense syl. 1 repetition
	Per cent	Per cent	Per cent	Per cent
8 hours	34.5	52.6	41.9	64.2
24 hours	42.2	31.1	20.3	66.3
2 days	44.5	39.1	33.2	72.2
6 days	...	50.7	57.6	74.6
30 days	...	79.8	76.1	78.9

We may compare these results with the results obtained by more recent investigators. Tsai experimented with associated pairs,[89] Seibert had also associated pairs and Bassett calculated the retention on history.[90]

Tsai—Amount forgotten in percentages of amount retained in the first recall:

1 day	2 days	3 days	5 days	7 days	10 days	14 days
34.4%	42.5%	45.4%	52.8%	56.3%	64.0%	71.0%

Bassett—Amount forgotten in term of amount retained in first test:

4 months	8 months	12 months	16 months
13.99%	18.49%	23.28%	28.04%

Seibert—Amount forgotten in terms of perfect score:

50 minutes Per cent	2 days Per cent	10 days Per cent	40 days Per cent
18 to 25	27 to 37	25 to 46	49 to 59
7 to 22	12 to 22	12 to 24	30 to 42
22 to 33	32 to 38	25 to 28	34 to 41
16 to 22	19 to 30	20 to 39	40 to 56
16 to 22	23 to 35	24 to 34	33 to 59

[88] Finkenbinder, E. O.: The Curve of Forgetting. Am. Jour. of Psy., 1913, Vol. 24, pp. 8-32.

[89] Tsai, L. L.: Relations of Retention to the Distribution of Learning. Jour. Exp. Psy., 1927, pp. 30-39.

[90] Bassett, J., and Brooks, F. D.: The Retention of American History in the Junior High School. Jour. Educ. Research, 1928, pp. 195-202.

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If any general conclusions could be drawn from these tables, we could probably say that associated pairs are better remembered than series of non-sense syllables, and facts are better remembered than words. All of which emphasizes anew the necessity for investigators in a particular field to investigate with the special material with which they are directly concerned.

2. *The Form of the Curve of Forgetting.* Several curves of forgetting were obtained in the course of this investigation. From a perusal of these curves the following conclusions can be drawn:

(a) All these curves show a general negative acceleration.

(b) There is a large original drop between the first recall (50 minutes after the first learning) and the second recall after 2 days.

(c) The curve from the second day to the tenth day is almost in every case horizontal. Sometimes, as in Fig. 6, it exhibits a positive acceleration. This phenomenon happens in every case where there has been a relearning at the end of the second day. That a relearning should make up for the natural loss over a period of 10 days is of interest.

(d) In cases where no relearning took place the second day, the curve does not present this horizontal line.

(e) After the tenth day, the curve slopes very gradually towards the base line.

Our curves of forgetting seem to show the characteristics of those found by others.

Strong finds "a big initial drop and then a more gradual slope." [61]

Jones, "The curve of amount retained descends rapidly at first, changes abruptly to a slower descent and thereafter diminishes slowly towards the base line." [62]

Robinson, "All curves of memorizing take the negative acceleration form." [63]

[61] Strong, E. K.: Effect of Time Interval Upon Recognition Memory. Psy. Rev., 1913, Vol. 20, pp. 339-372.

[62] Jones, Harold: The Effect of Examination in Permanence of Learning. Arch. of Psy., 63-68, n. 68.

[63] Robinson, E. S.: The Relative Efficiency of Distributed and Concentrated Study in Memorizing. Jour. Exp. Psy., 1921, Vol. 4, pp. 327-343.

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Bean, " Seven days is the limit of rapid forgetting according to the method of reconstruction." [64]

Finkenbinder, " The curve of forgetting for nonsense syllables as determined by lapse of time is an uniformly progressive curve much as Ebbinghaus found." [65]

Tsai, " The curve of forgetting exhibits the characteristics of negative acceleration." [66]

Robinson, " The memory curve for all length show a general negative acceleration." [67]

General Conclusion. In the course of this investigation several important facts have been called to our attention. The most important one is probably the fact that the element of chance must be taken into careful consideration in experiments in this field. As we proceeded with the investigation, we found such a variability in the performances of the same function by the same group, that the element of chance appeared more and more important until we are now convinced of the unreliability of a single experiment in a given field. Our opinion is that experiments of this sort must be carefully controlled, done in the most scientific manner and that the findings must be carefully analysed before any conclusions can be warranted. We found that consistency in the results is probably as good a check as any of the reliability of the results. Spaced relearnings, using the same method as in the original learning, will do much to counterbalance the element of chance in the first learning. Then a comparison of the general findings with the results of other experiments in related fields may help to add confidence or a wholesome distrust in our findings. This of course should not be exaggerated, and findings of others should not be either accepted

[64] Bean, C. H.: The Curve of Forgetting. Arch. Psy., n 16-21, n 21, 1912.

[65] Finkenbinder, E. O.: The Curve of Forgetting. Am. Jour. Psy., Vol. 24, 1913, pp. 8-32.

[66] Tsai, L. L.: Relations of Retention to the Distribution of Learning. Jour. Exp. Psy., 1927, pp. 30-39.

[67] Robinson and Heron: Results of Variations in Length of Memorized Material. Jour. Exp. Psy., Vol. 5, 1922, pp. 428-448.

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blindly without weighing carefully the value of the evidence given.

The second important point to be considered is the value of the mass of experiments done in the field of psychology. We could not help being impressed, while going over the work done in our particular field, by the need of a thorough overhauling of the mass of data that have been accumulating since the pioneer days of psychological investigation. We still go back for our bibliographies to the beginning of experimentation, and we accept all the findings: experiments made on one individual or a group of three or five; experiments with no control whatever; experiments where the technique is so faulty or the interpretation so obviously wrong that the value of the findings are almost nil. These early experiments are accepted as well as the most recent *significant* ones, and are given a place in our books on psychology and their findings are influencing our methods of teaching. No wonder the results seem to contradict each other on almost every point. Why not get rid of the obsolete, meaningless or inconclusive experiments? There would probably be a great deal of contradictory evidence done away with by means of this simple procedure. True, there will still be some points on which experimenters will not agree; this means of course the need of more experimentation until we may be reasonably sure of our conclusions. Why should one experiment in a given subject be considered conclusive and sufficient to ascertain facts of the most difficult, changeable, and elusive nature: namely, that of the functions of the human mind? What physicist or chemist would be willing to accept as general laws the findings of one individual making one experiment? Yet, this is done too often in our field. In our constant research for original investigations, we do not relish repeating experiments done by others, however useful the work may be. Our plea is for more and more experiments, using the best available technique, weighing meticulously all evidence before announcing results either in psychologies or in books on teaching methods.

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A critical evaluation of our results in the light of other investigations seems to furnish ground for the following tentative conclusions:

1. Studying aloud is a more efficient method of study than studying silently or aloud with a written recall.

2. Foreign vocabularies studied in associated pairs (native-word, foreign-word) are better learned than when studied in sentences.

3. The whole method is superior to the part method for the study of a list of associated pairs.

4. Distributed relearning over a period of 10 days is a more efficient method than the same amount of relearning concentrated in one sitting at the end of 10 days.

5. The recitation method is superior to the reading method as a method of learning.

6. There is a negative correlation between the time of learning and the amount retained.

7. There is a positive and fairly high correlation between the amount retained in different methods of learning.

8. There is a positive and fairly high correlation between the amount retained in the immediate and delayed recall (40 days).

9. The curve of forgetting has a negative acceleration.

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